

**SOCIOPOLITICAL DEVELOPMENT
AND A
MONUMENTAL EARTHWORK LANDSCAPE
ON BABELDAOB ISLAND, PALAU**

Jolie Liston

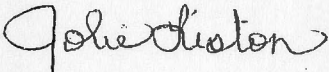
A thesis submitted for the degree of Doctor of Philosophy
of The Australian National University.

Department of Archaeology and Natural History
School of Culture, History and Language
College of Asia and the Pacific
Australian National University
Canberra, ACT

October 2013



Except where stated otherwise, this thesis is based entirely on my own research.


Jolie Liston

October 24, 2013

October 24, 2013

ACKNOWLEDGEMENTS

Many people contributed to arriving at our current understanding Palau's earthworks. I extend my deepest appreciation to Rita Olsudong for her friendship and all she taught me about Palau's heritage. I am grateful to the assistance of Dave Tuggle, Geoff Clark, Rona Ikehara-Quebral, Doris Hutton, and Kelly Marsh for helping me through this thesis.

The work was completed under the guidance of Minister Tina Rehuher of the Ministry of Community and Cultural Affairs and Director Dwight Alexander of the Palau Bureau of Arts and Culture. I am grateful to them and the entire staff at the Bureau of Arts and Culture and the Belau National Museum for all the million courtesies they extended to me during the research.

Palauan archaeologist Vince K. Blaiyok shared his vast knowledge and experience and was particularly helpful in providing support during my years in Palau. His dedication to the preservation and management of Palau's cultural resources knows no bounds.

The project's success is due to innumerable contributions and acts of kindness from scores of individuals. My deepest gratitude is extended to all the archaeologists and anthropologists who assisted in all aspects of learning about earthworks. Thank you to Myra Tomonari-Tuggle, Melson Miko, Tim Rieth, Meked Ngirmekur, Mike Desilets, Ethan Cochrane, Steve Athens, David Welch, Tom Arakaki, Gener Moon, Oliver Delpirt, Jenny Hesus, Gail Murakami, Alfin Mineich, Bruce Masse, Barkley Bandarii, Sarah Phear, Rayvan Adelbai, Estanly Domingo, Coral Magnuson, John Sokau, Kiblas, Kenny Merar, Mark Willis, Matais Beketaut, Tina Mangieri, Jefferson Blaiyok, Madelsar, Junior Hosei, Felicia Mitilab, Pat O'Day, Clayton Ngiraked, Linnea, Lane Ngirakesiil, Ted, Moses Ngirakesiil, Boyd Dixon, Renguul Ngirkiechol, Viola Ngirngetrang, Sylvia, Peter Ngitong, Priscilla Osilek, Kedel Sisior, McGandhi Tewid, Sarah Billengren, Flavin Idip, Karen Nero, Shakespeare Ngirmekur, Harley Manner, Simeon, Dieter Olkeriil, Sheldon Rengulbai, Matt Bell, Skarumo Rengulbai, Rocky Sokau, Maria Trinidad, Robin Tucheliaur, Jewett Melemalt Blaluk and countless others.

I want to thank the many people who live in or are passing through Palau and shared their insights into the island's unique cultural heritage, including Vicky Kanai, Imelda Blailes, Andrew Shiro, Risong, Harvey, Julita Tellei, Pat and Lori Colin, Ann Singeo, Selma, Jerry Nabeyama, Lincoln, Freda Harvey, Tmur, Tarita and Tiare Holm, Mike Balick, Umai Basilius, Akiko Iida, Ivy, Floriano Felix, Sameel, Ann Kitalong, Obak, Harvey, Charlene Mersei, the members of Bent Prop, Augusta, Ron Leidich, Maura Gordon and Ileb. Thank you to all those who are acknowledged here and the many more not listed for their invaluable assistance.

Thank you to Henry Wolter, USGS Geospatial Liaison for the Pacific Islands, the Palau Bureau of Land and Survey, the Bernice P. Bishop Museum and Dr. Pat Colin and the Coral Reef Research Institute in Palau for assistance with aerial photographs. Bob Gavenda and others in the Natural Resources Conservation Services and Dr. Golabi were extremely helpful in the investigations of Palau's soils.

Ultimately, I am eternally grateful to the people of Palau for allowing me to wander around their island and study their earthworks.

Many people consider a survey to be a simple and easy way to collect data. However, it is not always as straightforward as it seems. The design of the survey, the way the questions are asked, and the way the data are analyzed can all have a significant impact on the results. It is important to be aware of these factors and to take steps to minimize bias and error.

There are many different types of surveys, each with its own strengths and weaknesses. Some are more suitable for certain types of research than others. It is important to choose the right type of survey for your research and to use it correctly.

The survey is a common method of data collection. It is used to collect information from a large number of people. The survey can be conducted in many different ways, such as by mail, by telephone, or by computer. The survey can be used to collect data on a wide range of topics, such as attitudes, beliefs, and behaviors. The survey is a valuable tool for researchers, but it must be used correctly to produce reliable results.

There are many different types of surveys, each with its own strengths and weaknesses. Some are more suitable for certain types of research than others. It is important to choose the right type of survey for your research and to use it correctly.

The survey is a common method of data collection. It is used to collect information from a large number of people. The survey can be conducted in many different ways, such as by mail, by telephone, or by computer. The survey can be used to collect data on a wide range of topics, such as attitudes, beliefs, and behaviors. The survey is a valuable tool for researchers, but it must be used correctly to produce reliable results.

There are many different types of surveys, each with its own strengths and weaknesses. Some are more suitable for certain types of research than others. It is important to choose the right type of survey for your research and to use it correctly.

ABSTRACT

This thesis investigates the mechanisms underlying the early emergence of monumentality on an Oceanic island and the correlation between the development of monumental architecture and the long-term processes of sociopolitical evolution. Babeldaob in the Palau archipelago of western Micronesia was selected for this study due to the nature of its monumental earth architecture. Monumental in both horizontal scale of interconnected complexes and dimensions of individual structures, Babeldaob's earthworks emerged close to a millennium earlier, and were abandoned several centuries before, the advent of monumentality on other Pacific island groups. Unlike elsewhere in Oceania, Babeldaob's monumental structures form extensive conjoined clusters containing a multitude of morphological forms that served simultaneous practical and symbolic functions.

The underlying structure of the investigation is dual-processualism, the co-existing network and corporate political economic orientations chosen by emerging leaders to create and legitimize their power and prestige. These strategies rely on interdependent political, ideological, ritual and economic power sources. Distinguishing between corporate and network modes employed in Palau's Earthwork Era (2400-1100 calBP) is a heuristic tool for assessing the temporal transformations in spatial dimensions, patterning and practical and ideological roles encoded in Babeldaob's earthworks.

This research presents a new understanding of the chronological development, construction processes, spatial organization and intertwined tangible and intangible uses of earthworks based on stratigraphic excavations, pedestrian survey, spatial analysis and radiometric dating. These data sources support a new working model of the evolution of Babeldaob's sociopolitical complexity in a dual-processual framework.

Babeldaob's sociopolitical organization model posits development from heterarchical kin groups, to competitive chiefdoms and finally to rival decentralized polities. Corporate and network political economic strategies fused to maintain a level playing field driving a volatile sociopolitical period. With a staple economy based on land, labour and the production of

surplus, corporate leadership strategies prevailed. However, rival factions and competing politics were extremely dynamic as they manoeuvred for prestige and wealth through network alliances and warfare. By the end of the Earthwork Era, there is a clear expression of economic stratification and personal aggrandizement.

The Earthwork Era political economy appears to be based on staple and ritual finance with the most valuable commodity the landesque capital and associated ritual, occupational and defensive earth architecture that further increased the economic value of the built landscape. These structures embodied a complex merger of energy investment, ancestral ties, ritual association, staple wealth and social bonding.

Given Babeldaob's high precipitation, sloping land, and the instability and low native fertility of its highly weathered soil, development of step-terraces was an effective strategic choice to prevent land degradation and support a viable agricultural system. The recognition of the complexity and vulnerability of earthwork construction and dryland agriculture in these particular edaphic and climatic conditions led to the development of ritual behaviours associated with both activities. Earth structures dedicated to these performances bind staple finance to the dominant ideology.

CONTENTS

ACKNOWLEDGEMENTS	3
ABSTRACT	5
CONTENTS	7
FIGURES	11
TABLES	13
1.0 INTRODUCTION	14
1.1 Research Objectives	14
1.1.1 Development of a Monumental Earthwork Landscape	14
1.1.2 Emergence of Sociopolitical Complexity	15
1.2 Significant Issues	16
1.2.1 Socionatural Perspective	16
1.2.2 Monumental Architecture	18
1.2.3 Sociopolitical Complexity	19
1.3 Thesis Organization	21
2.0 LANDSCAPE, MONUMENTAL ARCHITECTURE AND SOCIOPOLITICAL COMPLEXITY	24
2.1 An Interrelated Landscape	24
2.1.1 A Spatial Scale of Analysis for Earthworks	26
2.1.2 Historical Ecology	27
2.1.3 Landscape Archaeology in Palau	28
2.2 Development of Sociopolitical Complexity	29
2.2.1 Sources of Power	30
2.2.2 The Political Economic Strategies of Dual-Processualism	32
2.3 Monumental Architecture as Archaeological Data	34
2.3.1 Architectural Correlates of Sociopolitical Organization	38
2.4 Summary	39
3.0 ENVIRONMENTAL AND CULTURAL CONTEXT	42
3.1 Babeldaob Island	42
3.2 Long-Term Transformations to Babeldaob's Coastline	44
3.2.1 Sea Level and Tectonic Activity	44
3.2.2 Erosion and Sedimentation	45
3.3 Climate and Climate Variability	46
3.4 Volcanic Soil and Fertility	49
3.5 Resources and Vegetation at Settlement	50
3.5.1 Vegetation Regimes	51
3.5.2 Protein Resources	52
3.5.3 Plant Resources	53
3.6 Earthworks in Tradition and Archaeology	55
3.6.1 Indigenous Perspectives and Ethnohistoric Accounts	55
3.6.2 Archaeological Perspectives	57
3.7 Summary: A Socionatural Landscape	59
4.0 ARCHITECTURAL FORM AND SPATIAL ORGANIZATION	62
4.1 Morphological Classification of Modified Terrain	63
4.1.1 Structural Components	64
4.1.2 Ideal Type Complexes	71
4.2 Size of Structures and Complexes	74

4.3	Extent of Earthworks	75
4.3.1	Spatial Analysis Methods.....	76
4.3.2	Extent of Modification	77
4.3.3	Relationship to Natural Landscape	77
4.4	Patterned Distribution	81
4.5	Summary: A Monumental Landscape	84
5.0	FIELD AND LABORATORY INVESTIGATIONS	86
5.1	Background to Archaeological Fieldwork.....	87
5.1.1	Previous Archaeological Investigations	89
5.2	Field and Laboratory Methods.....	89
5.2.1	Laboratory Methods	91
5.3	Sisngembang Crown Complex	94
5.3.1	Anthropological Background	95
5.3.2	Earthwork Description	96
5.3.3	Field and Laboratory Investigations.....	98
5.3.4	Discussion and Sequence of Events	106
5.4	Ked era Aranguong.....	110
5.4.1	Anthropological Background	111
5.4.2	Earthwork Description	111
5.4.3	Field and Laboratory Investigations.....	112
5.4.4	Discussion and Sequence of Events	114
5.5	Ngedelchong Crown	116
5.5.1	Field and Laboratory Investigations.....	117
5.5.2	Discussion and Sequence of Events	120
5.6	Roismelech Crown Complex	122
5.6.1	Anthropological Background	122
5.6.2	Earthwork Description	124
5.6.3	Field and Laboratory Investigations.....	124
5.6.4	Discussion and Sequence of Events	127
5.7	Summary.....	130
6.0	AN ENGINEERED LANDSCAPE.....	132
6.1	Construction Challenges and Techniques	132
6.1.1	Slope Gradient.....	134
6.1.2	Controlling Groundwater	134
6.1.3	Soil Discontinuities	135
6.1.4	Construction Phases	137
6.1.5	Discussion	139
6.2	Investment of Labour.....	139
6.3	Labour Management.....	142
6.4	Social Aspects of Construction.....	144
6.6	Summary.....	145
7.0	EARTHWORK CHRONOLOGY	148
7.1	Chronological Methods and Difficulties.....	149
7.2	Radiocarbon Assays.....	151
7.3	Chronological Framework of Babeldaob's Earthworks.....	154
7.4	Summary	161
8.0	AGRICULTURE AND STEP-TERRACES.....	164
8.1	Models of Agricultural Development.....	164

8.2 Evidence for Interior Cultivation Systems	166
8.3 Environmental Motivation for Step-Terrace Production Systems	169
8.3.1 Erosion Control	169
8.3.2 Water Management	171
8.3.3 Soil Fertility	172
8.4 Traditional Subsistence Strategies	173
8.4.1 Yields and Labour Requirements	177
8.5 Agricultural Intensification and Staple Finance	178
8.6 Summary	179
9.0 MONUMENTS AS RITUAL	182
9.1 Ritual Ceramic Vessels	183
9.1.1 Ritual Vessel Attributes	184
9.2 Ceremonial or High Status Centres	186
9.3 Ritual Cultivation	189
9.4 Ritual Construction	191
9.5 Burial Practices	193
9.6 Summary	197
10.0 POLITICIZING THE LANDSCAPE	200
10.1 Political Economy	203
10.2 Competition and Warfare	206
10.2.1 Warfare in Traditional History	207
10.2.2 Palauan Defensive Features	209
10.3 Ideological Symbols	212
10.4 A Defensive Settlement Pattern	213
10.4.1 Inter-District Settlement Pattern	215
10.4.2 Intra-District Settlement Pattern	216
10.5 Summary	219
11.0 MODELING EARTHWORK ERA SOCIOPOLITICAL ORGANIZATION	222
11.1 Early Phase	222
11.1.1 Architecture	224
11.1.2 Sociopolitical Organization	224
11.2 Middle Phase	225
11.2.1 Architecture	226
11.2.2 Sociopolitical Organization	230
11.3 Late Phase	233
11.3.1 Architecture	233
11.3.2 Sociopolitical Organization	234
11.4 Abandonment	236
11.4.1 Causal Variables	238
11.5 Summary	243
12.0 CONCLUSION	246
12.1 The Earthwork Era Political Economy	247
12.2 A Monumental Earthwork Landscape	248
12.3 Signatures of Leadership Strategies	250
12.5 Problems and Future Work in Modelling the Earthwork Era	253
REFERENCES	256
APPENDIX A. TABLES	282

APPENDIX B. FIGURES309

APPENDIX C. PALAUAN ARCHAEOLOGY GLOSSERY357

APPENDIX D. TRADITIONAL SOIL CLASSIFICATION361

APPENDIX E. EARTHWORK RADIOCARBON DATES363

FIGURES

Figure 1. Location of Palau in the western Pacific and the states in Babeldaob.....	310
Figure 2. Stitched image of Ked era Aranguong complex in Ngaremlengui.....	311
Figure 3. Crown, step-terrace and gully complex in Aimeliik. Photo by Pat Colin.	311
Figure 4. Aerial view of earthwork complexes in Aimeliik Earthwork District	312
Figure 5. Geological map of Babeldaob	313
Figure 6. Elevation range on Babeldaob.....	314
Figure 7. Weighted average percent slope on Babeldaob.....	315
Figure 8. Watersheds in Babeldaob.	316
Figure 9. Soils on Babeldaob.....	317
Figure 10. Current vegetation regimes on Babeldaob.	318
Figure 11. Wide mangrove forest below earthworks in Ngaremlengui.....	319
Figure 12. The Ngeskebei step-terraces in Ngaremlengui.....	320
Figure 13. High step-terraces on Ngemkeang in Ngaremlengui.....	320
Figure 14. Basin in Uluang crown in Ngaremlengui..	321
Figure 15. Inside the basin on the summit of the Oratelruul crown in Ngiwal.....	321
Figure 16. Low modified ridge backed by the high modified Ngebedech ridge capped by a paved level area. Two Type I complexes in Aimeliik.	322
Figure 17. Tablemeduu modified ridge (Type I) in Ngaraard.	322
Figure 18. Ngerkelalk Type IIIb complex in Aimeliik.	323
Figure 19. A gully containing step-terraces in Ngatpang's Type II Ngermedangeb complex.....	323
Figure 20. Low rectangular crown with berm on one side in Airai.	324
Figure 21. Two views of Ngatpang's Type II Ngermedangeb complex.....	325
Figure 22. Crown shapes as drawn by Hijikata (1993).....	326
Figure 23. Ngerebngai triangular crown in Ngaraard.....	326
Figure 24. Low circular crown on Ongelwatel in Ngaremlengui.	327
Figure 25. Ngermelkii crown and ditch in Ngatpang.	327
Figure 26. Infilled ditch around base of crown with basin on Oratelruul crown in Ngiwal. ..	328
Figure 27. A Type IIIa complex in Ngardmau.	329
Figure 28. Ongelwatel saddle terrace and Ngeskebei step-terraces, Ngaremlengui.....	329
Figure 29. A Type II complex in Aimeliik in 1976 aerial photograph.	330
Figure 30. A Type III complex in Ngaraard.	330
Figure 31. Two views of Roisingang, a type Type IIIb complex in Ngaraard..	331
Figure 32. Views of the Ngeskebei Type IV complex in Ngaremlengui.....	332
Figure 33. Location of Babeldaob's earthworks and unsurveyed land.....	333
Figure 34. Approximate area of Babeldaob's large earthwork districts.	334
Figure 35. Ngaremlengui, showing Ngchemesed and Ked era Aranguong areas.....	335
Figure 36. Map of Ngaremlengui showing locations of sites investigated in thesis.....	336
Figure 37. Location of Roismelech in Melekeok.....	337
Figure 38. Sisngembang overlooking entrance into Ngeremeduu Bay in Ngaremlengui.....	338
Figure 39. Earthworks in the Ngchemesed area of Ngaremlengui.	339
Figure 40. Sisngembang, Trench 16, plan and profile view.	340
Figure 41. Sisngembang, Trench 16, burial pits.	340
Figure 42. Sisngembang, Trench 16, whole pot on burial pit.....	341
Figure 43. Reconstructed pot from burial pit on Sisngembang.	341
Figure 44. Sisngembang, Trench 15, profile.	342
Figure 45. Sisngembang, Trench 15. Retaining wall above. East wall below.....	342
Figure 46. Sisngembang, Trench 11, east wall profile.....	343

Figure 47. Sisngebang, Trench 11, northeast end with pit at base.	343
Figure 48. Sisngebang, Trench 11, pottery cache.....	344
Figure 49. Pot 3 with decoration from Sisngebang pottery cache.....	344
Figure 50. Pot 1 left, Pot 2 below from Sisngebang pottery cache.	344
Figure 51. Ongelwatel, whole pot beneath stone paving.....	345
Figure 52. Reconstructed pot from Ongelwatel.....	345
Figure 53. Aerial photograph of Ked era Aranguong area in Ngaremlengui.	346
Figure 54. Ked era Aranguong in Ngaremlengui in 1992 aerial photograph.	346
Figure 55. Ked era Aranguong, Trench 9, profile.	347
Figure 56. Ked era Aranguong, Trench 9, ditches in plan and profile.	347
Figure 57. Ked era Aranguong, Trench 5, wall profiles.....	348
Figure 58. Ked era Aranguong, Trench 5, northeast corner wall profile.....	348
Figure 59. Ngedelchong crown profile.....	349
Figure 60. Center and east end of Ngedelchong crown profile.	350
Figure 61. Odalmelech monolith on coast below Roismelech.	351
Figure 62. <i>Klidm</i> in Chelab village in Ngaraard.....	351
Figure 63. Schematic illustration of portion of Roismelech.....	352
Figure 64. Cut terrace at Roismelech showing coral alignments with whole pots.....	352
Figure 65. Roismelech profile.	353
Figure 66. Central portion of Rosimelech profile.....	353
Figure 67. Whole pots on prepared surface at Roismelech.	354
Figure 68. Reconstructed pots from Subfeature 1, Roismelech..	354
Figure 69. Dryland farming in gully at base of crown complex in Ngchesar.	355
Figure 70. Whole pots and rock-filled pit on Tabelmeduu ridge.	356
Figure 71. Pottery cache under earth platform at Tabelmeduu ridge.	356

TABLES

Table 1. Tendencies of Corporate and Network Strategies	283
Table 2. Potential Architectural Correlates of Dual-Processual Strategies in Earthwork Era Palau.	283
Table 3. Babeldaob's Major Watersheds.	284
Table 4. Aerial Extent of Acidic Soils in Pacific Island Volcanic Islands	284
Table 5. Babeldaob's Major Landscape Categories, Soil Map Units and Soil Series	285
Table 6. Chemical and Physical Properties of Prevalent Babeldaob Soil Series.	286
Table 7. Soil Property Ranges for Major Soil Groups.	286
Table 8. Babeldaob Land Cover.	287
Table 9. Prominent Plants in Babeldaob's Major Environmental Zones.	288
Table 10. Earthwork Elevation Intervals.	289
Table 11. Earthwork Slope, Weighted Average.	289
Table 12. Earthworks in Geological Formations.	289
Table 13. Earthworks in Vegetation Categories.^	290
Table 14. Earthworks in Soil Map Units.^	290
Table 15. Summary of Fieldwork and Laboratory Analysis.	291
Table 16. Reconstructable Pottery Vessels.	292
Table 17. Charcoal Taxa Identification.	293
Table 18. Radiocarbon Date Ranges.	296
Table 19. Chemical Soil Analysis.	299
Table 20. Soil Description.	300
Table 21. Archaeobotanical Analysis.	302
Table 22. Cultural Sequence Model for Palau.^	303
Table 23. Agricultural Crops Suitable to Babeldaob Soils.	306
Table 24. Taro corm yields in three cultivation systems in Palau	306
Table 25. Vessels with Ritual Association in Earthwork Sites.	307

1.0 INTRODUCTION

Visually impressive and morphologically diverse earth architecture dominates the topography of Babeldaob, the largest island in the Palau archipelago in western Micronesia (Figure 1). Archaeological and paleoenvironmental investigations identify Babeldaob's earthworks as attaining monumental proportions in both structural size and extent of modified terrain about a millennium before, and lying abandoned several centuries earlier than, monumentality appeared on any other Pacific Island group. The correlation of monumental architecture with the development of sociopolitical complexity suggests that Palau developed a highly stratified society long in advance of the remainder of Oceania.

Unoccupied at Western contact in the late eighteenth century and absent from Palau's rich body of oral traditions, interpreting earthwork age and function falls solely in the archaeological realm. The historical trajectory of Babeldaob's monumental earthwork landscape and the sociopolitical system that built and used the structures remains unclear. To better understand these major processes and the relationship between them, this thesis explores the role played by the built environment in early sociopolitical development in the political economic framework afforded by dual-processualism.

1.1 Research Objectives

This thesis examines the mechanisms underlying the early emergence of monumentality on an Oceanic island and the correlation between the development of monumental architecture and the long-term processes of sociopolitical evolution. The political economic strategies employed through time are explored using the chronological, functional and spatial evidence embedded in architecture. Interpretations of these data sets allow for the presentation of an evolutionary model of sociopolitical complexity during Babeldaob's Earthwork Era.

1.1.1 Development of a Monumental Earthwork Landscape

The magnitude of Babeldaob's modified terrain, the multitude of structural forms and the antiquity of the engineered landscape has only been recognized in the past decade (Liston and

Tuggle 2006; Liston 2007a, 2009, 2011a; Phear 2007). It is now known that extensive clusters of monumental earth architecture supported the majority of community activities for more than 1200 years of Palau's history, a period extending from ca. 2400–1100 calBP that is labelled the Earthwork Era.

Earth structural components are integrated into earthwork complexes that appear to serve multiple purposes simultaneously. The distributional patterning, enormity and elaboration of these earth structures suggest that, although supporting practical uses, taken as a whole they primarily functioned to symbolize the relative status of the chief and their ability to command community labour and military strength (Liston 2007a:382). Earthwork should therefore transform in use, patterning, morphology and size as Babeldaob's society evolves over a millennium of occupation.

The first objective of this study is to provide a framework of earthwork development appropriate for exploring the role played by the constructed landscape in the evolution of Earthwork Era sociopolitical complexity. Changes in sociopolitical organization and social structure should be observable in transformations in the interrelated variables of architectural form, spatial distribution, dimensions, construction techniques and function. These transformations can be used to interpret both evolving sociopolitical complexity and the contribution architecture made to these developments.

1.1.2 Emergence of Sociopolitical Complexity

The nature of Palau's Earthwork Era sociopolitical organization is little understood. With the existing data, Liston and Tuggle (2006) presented a 'best fit' model suggesting that the spatial patterning and monumentality of Babeldaob's earthwork landscape is indicative of small fortified polities. They state that:

The nature of these polities is uncertain, and may have ranged from loose alliances and federations (the contact-period ethnographic pattern) to more centralized chiefdoms. The possibility of centralized political structure is suggested by the extent of the terrace complexes and by indications of complex burials of high-ranking individuals in some of the crowns (Tuggle 2005), by the extent and size of the earthworks, and by the labour force implied by the earthworks. [Liston and Tuggle 2006:165]

Kirch (2000:190) cautions that rather than Palau's earthwork construction being undertaken by a centralized hierarchy in a single event, local groups may have gradually built and expanded the structures through time. At this early stage of archaeological knowledge, without a sufficiently robust material record, Snyder et al. (2011) question defining levels of early Palauan social complexity at all.

The second objective of this research is to investigate the evolutionary development of the scale and scope of Earthwork Era sociopolitical complexity. This process is explored by placing the long-term transformations in Babeldaob's monumental architecture in a dual-processual framework. In this approach the trajectory of sociopolitical transformations is tracked through the material remains of alternative but co-existing leadership strategies employed by emerging leaders to acquire authority and prestige (Blanton et al. 1996). Underlying these political economic orientations are political, ideological, ritual and economic power sources.

1.2 Significant Issues

Palau offers an ideal opportunity to examine the relationship between monumental architecture and the long-term processes of sociopolitical development because of the nature of Babeldaob's earthworks. The extent and chronological depth of the multifunctional earth structures provides an expansive spatial, temporal and versatile data set. This wide range of evidence allows for identifying the transformations in political economic strategies as manifested in monumental earthwork architecture from the socionatural standpoint afforded by historical ecology and landscape analysis.

The following section examines the significance of the investigation's primary approaches and how each is addressed in the investigations.

1.2.1 Socionatural Perspective

Nowhere in Oceania is monumentality as extensive as it is on Babeldaob where massive earth structures create expansive conjoined clusters of shaped terrain. This is not a cultivated

landscape exclusively dedicated to agricultural production but the foundational stage for all aspects of ancient Palau's social, political and economic society. Babeldaob offers a singular opportunity to explore the interconnection of the social and natural as processes in cultural and environmental landscape formation due to the extent of modified terrain and its ancient abandonment.

A primary perspective in this thesis is the historical development of Babeldaob's earthworks and sociopolitical complexity as components of a dynamic and complex interrelationship between the social and the natural environment. The 'landscape' is both the product and creation of this relationship.

Rather than use one of the multiple rather contested theoretical perspectives of landscape offered by current archaeological theory (Tilley 1994; Knapp and Ashmore 1999; Anschuetz et al. 2001), the complexity of the earthwork data set makes it more appropriate to adopt a broad conceptualization of landscape as both space and place. In these investigations, 'landscape' refers to the spatial unit of analysis, a structure for integrating multiple practical functions and phenomenological concepts, a term to refer to the environmental terrain and contains spatial information.

As a relict landscape the earthworks covering much of Babeldaob are little impacted by historic development and retain much of their integrity. The intensity of the modifications to the natural landscape and the resultant transformations to the natural environment exemplifies the dynamic between social and ecological factors as integral to culture change. This allows for these investigations to question the motivations behind such a huge investment in reshaping the natural environment and what the consequences of these past human land use practices are through time.

The spatial organization of Babeldaob's earthworks in relation to the natural environment is explored with spatial analysis. Data was collected through pedestrian survey and aerial photographs before being analysed in a GIS environment. The analysis provides architectural patterning and distributional information and tracks the relationship between the built

environment and topography, vegetation regimes, soil conditions and geological formations. This provides insight into the contributions made by the natural environment to political economic strategies chosen in settlement patterns, subsistence regimes and technological approaches and helps identify the long-term impacts of these behaviours on the environment.

1.2.2 Monumental Architecture

The Pacific is replete with monumental architecture in the form of stone and earth fortifications, tombs, boundary markers and ritual or ceremonial structures while cultivated field systems spread across wide expanses of many islands (Groube 1970; Best 1993; Graves and Sweeney 1993; Graves and Ladefoged 1995; Sand 2002). The prominent display of wealth and authority through this architecture imparts the dominant ideology to the population to create and enforce chiefly power and sociopolitical organization (DeMarrais et al. 1996; Earle 1997). The Pacific's substantial body of oral histories recounts the significant role these structures played as an effective and persuasive tool in the discourse about power relations.

Only in Palau does monumental architecture support not just one or two but all of the secular and sacred functions found in the remainder of the Pacific's massive structures. The wide variation in morphological forms of Babeldaob's earthworks shows they are substantially different in kind than the cultivated landscapes identified elsewhere in Oceania. Archaeological evidence identifies Palau's earthworks supported the full range of community activities. They held burial grounds and habitations; were used for water management, trails, agriculture and other infrastructure; contained defensive elements and served as boundary markers, lookouts and signal towers; and played ceremonial and ritual roles. Although performing these practical uses, the distributional patterning, size and morphology of the complexes suggest to Liston and Tuggle (2006; Liston 2007) that as a whole earthworks primarily functioned as multi-faceted symbols of polity power.

With little reference to earthworks in Palau's traditional narratives, determining earthwork age, function and the role they played in sociopolitical development relies almost exclusively on the physical evidence unearthed in archaeological and paleoenvironmental

investigations. With the goals of examining evidence for the differing uses of earthworks and retrieving soil, charcoal and archaeobotanical samples for palynological and pedological analysis and radiocarbon dating, archaeological excavation was conducted in seven earthwork sites—three crown complexes, two ridgeline sites, and two step-terrace complexes.

Stratigraphic analysis was directed toward identifying intact subsurface deposits and specialized subfeatures related to periods of pre-Contact occupation and documenting site formation processes. The interpretation of stratigraphic exposures provided for an assessment of earthwork construction techniques to explore the scope of energy and labour management practices invested in their construction. This stratigraphic analysis and the recovery of wood charcoal from deeply stratified deposits, soil floristic samples and whole pottery vessels were the primary means of data collection from the excavations.

Radiometric dating of wood charcoal samples collected in archaeologically meaningful contexts is essential to establishing a chronological sequence of earthwork construction and use and the development of monumental architecture. This provides data important to exploring transformations in leadership strategies. Radiocarbon dating was conducted on point-provenienced carbonized plant material recovered from intact cultural features and cultural fill material with the potential to provide information relevant to identifying timing of specific events and phases of construction.

Artifactual information is helpful to determining site functions, activity areas, craft production and societal disparities. This dataset provides insight into the nature of intra- and inter-site economic and social relationships, identifies ritual, ceremonial or elite events, and, in Palau, is useful to establishing temporal sequences. The goal of traditional pottery collection was to document the intentional placement of whole vessels and pottery caches.

1.2.3 Sociopolitical Complexity

In Oceania, monumental architecture plays a pivotal role in explorations of the development of sociopolitical complexity (Kirch 1990a; Allen 1994; Kolb 1994; Graves and

Ladefoged 1995; Clark and Martinsson-Wallin 2007). By identifying the ability of a leader to command a large labour force, collect substantial surplus and coordinate and manage the construction process, the appearance of monumental architecture is generally interpreted to coincide with the emergence of the Pacific's chiefly societies.

Babeldaob's earth structures and extensive sculpted landscape attained monumental proportions close to a millennium before monumentality appeared elsewhere in the Pacific implying that Palau developed the first stratified hierarchical society in Oceania (Liston 2009). While massive and extensive structures are found on Babeldaob by approximately 1900 years ago it is not until about 800 years ago or a little later that other Oceanic architecture attained monumental proportions (Kirch 2000; Smith 2004; Clark and Martinsson-Wallin 2007). Furthermore, Babeldaob's monumental earthworks were essentially abandoned in their originally intended capacity several centuries before the advent of monumentality on other island groups and its re-establishment on Palau in a different form.

By examining the variables behind the early appearance of Babeldaob's monumental architecture, the trajectory of Palau's sociopolitical development and the relationship between the two processes, the investigations provide insights into the nature of the Pacific's hierarchical chiefdoms, the varied leadership strategies used by emerging elites in Oceania, and the roles of monumental architecture in acquiring power. These issues are examined with the framework of the interacting but alternative paths to sociopolitical complexity offered by dual-processualism (Blanton et al. 1996; Feinman 2000a, b). Distinguishing between the co-existing leadership strategies in a dual-processual framework is a heuristic tool for assessing the complex and varied processes in changing political economic organization.

Variations in the motivations and forms of exclusionary (network) and inclusionary (corporate) political economic strategies are identified with distinctive material and symbolic correlates (Blanton et al. 1996). As a prominent material manifestation of the methods chosen to negotiate power relationships, transformations in architectural function, spatial dimensions

and energy investment can elucidate the long-term dynamics of the economic, social and political system that created and used the structures.

The size, extent, varied functions, antiquity and long period of use of Babeldaob's earthworks offers the opportunity for the first large-scale investigation of the correlation of monumental structures and sociopolitical complexity using dual-processualism in the Pacific. Few scholars in Oceania have explicitly applied a dual-processual framework to the interpretation of architectural remains (Clark and Martinsson-Wallin 2007; Kolb 2011). Corporate strategies are often however identified as financing and creating the monumental architecture that strongly influenced the trajectories of Pacific sociopolitical development (e.g., Kirch 1990a; Graves and Sweeny 1993; Kolb 1994; Earle 1997; Simpson 2009). Simpson (2009:133) suggests that the construction of Rapa Nui's statuaries was facilitated by corporate strategies operating within a dominant network organizational system.

1.3 Thesis Organization

Chapter 1 introduced the central issues being investigated, the analytical data sets and the significance of the study to understanding the broader research questions in contemporary Pacific archaeology. Chapter 2 develops the theoretical framework of examining a monumental landscape in the political economic approach of dual-processualism. Chapter 3 synthesizes information pertaining to Babeldaob's physical environment and cultural sequence to provide contextual background for the archaeological interpretations.

Chapters 4, 5, 6 and 7 provide earthwork data sets. Chapter 4 analyses the spatial data acquired during archival research and pedestrian and remote sensing survey. A classification scheme for Palau's earthworks is proposed. Chapter 5 is documentation of the significant archaeological investigations conducted during thesis research. Chapter 6 discusses earthwork construction techniques and stages in relation to the environmental challenges and labour and management issues. Chapter 7 presents new radiocarbon assays and incorporates these findings into the earthwork chronological sequence.

Chapters 8, 9 and 10 are interpretations of earthwork functions based on archaeological excavations and spatial and laboratory analysis. Chapter 8 examines earthworks as cultivation features by discussing agricultural intensification, assessing their utility in light of environmental variables and reviewing traditional subsistence regimes. Chapter 9 addresses the uses of earthworks in a ritual capacity. After discussing whole ceramic vessels and ceramic caches unearthed in Babeldaob's terraces, the chapter provides evidence of ceremonial cultivation, ritual construction and structured burials in interior earth structures. Chapter 10 identifies how earthworks politicized the island landscape by identifying their role in the political economy, as territorial markers, defensive features and ideological symbols. These uses are incorporated into a discussion of Earthwork Era settlement patterns.

Chapter 11 develops a model for the development of Earthwork Era sociopolitical organization by linking political economic strategies to the monumental architecture. The thesis concludes with Chapter 12 by summing up the key subjects of political economy, the development of monumental architecture and the materialization of leadership strategies. This chapter ends with a discussion of the problematic issues encountered during the analysis and suggestions for future earthwork studies.

Appendices A and B contains tables, photographs and other figures referred to in the document. Appendix C is a glossary of Palauan terms useful in archaeological interpretations. Appendix D is a brief presentation of Palau's traditional soil classification with an oral history related to these names. Appendix E is a table of all radiocarbon assays retrieved from earthwork sites through 2011 providing contextual information.

2.0 LANDSCAPE, MONUMENTAL ARCHITECTURE AND SOCIOPOLITICAL COMPLEXITY

To examine the development of sociopolitical complexity, Babeldaob's earth structures are regarded as a principal dynamic component of the island's natural and cultural landscape. By structuring the research in this manner, human political economic strategies can be investigated at the intersection of architecture and the natural environment. This chapter develops the theoretical perspective used to explore these concepts in the processes of Palau's Earthwork Era sociopolitical evolution.

2.1 An Interrelated Landscape

Green (1993, 2002) identifies Pacific landscape archaeology as an inclusive term for settlement pattern studies in which all the symbolic, ecologic, spatial and economic dimensions, among others, are taken into consideration. Following Green, this work conceptualizes the landscape as the totality of the relationships between people and the environment they interact with, whether or not there is a physical manifestation of this relationship. In Oceanic islands, behaviours are enacted in the larger context of the surrounding lagoon, ocean, neighbouring islands and the wider region. The economic, social and political importance of engagement within this larger islandscape is acknowledged with the study grounded in Babeldaob's terrestrial landscape.

Several interconnected layers of landscape contribute to the investigations. All of Babeldaob is conceived as a socionatural landscape with humans choosing strategies within their physical surroundings. Strategies and the natural setting changed through time due to these behaviours and environmental perturbations. Radical transformations to the landscape through the construction of large-scale earthworks affects the natural system to impact the environment of both the builders and future populations (Redman 1999). The study of Babeldaob's earthworks as part of the larger socionatural landscape can illuminate the changing relationships between Palauans and the environment they inhabit.

By constructing earthworks, the Palauans created an engineered landscape that was so deftly crafted it continues to contour the terrain. As Lansing (1991) and Earle and Doyle (2008) discuss, engineered landscape refers to expansive topographically altered terrain that is built up over generations to contain multiple functioning types of permanent structures. Babeldaob's engineered landscape is of such massive dimensions and extent that it creates a monumental landscape like no other in the Pacific. Understanding how this landscape was built through time allows for exploring engineering techniques and methods, labour investment, management practices and the social variables involved in their construction. Significant transformations in construction track technological innovations but can also document changing societal goals for the use and function of the structures (Kolb 1997).

The distributional patterning, size and varied functions of these structures also identify a variety of landscapes. As agricultural features, Babeldaob's earthwork components form a cultivated or agrarian landscape. The structures used in producing crops are only a part of the larger modified terrain and do not resemble the cultivations systems covering significant portions of Fiji (Kuhlken 1994, 2002) or New Caledonia (Sand 1999, 2002). As many of Babeldaob's earthworks do not support agricultural production, the monumental landscape can not be perceived as directly dedicated to cultivation.

This identifies Babeldaob's engineered landscape as different in kind from other earthworks, public work systems and monumental structures throughout the Pacific. It is possible that Babeldaob's monumental earthwork landscape was a strategy chosen by the island's early inhabitants to sociopolitically construct the space and place they lived in. This proposal of the construction of a politicized landscape will be explored in the thesis through an assessment of earthwork distribution, size and function. For example, in a spatial sense, earthworks may impose structure on the landscape that would allow for examination of the production of authority and power. If the earthworks do represent a politicized landscape, the remains of such extensive and meaningfully charged structures on the archaeological landscape lends itself to evaluating the nature of sociopolitical strategies.

This conceptualization of landscape acknowledges those intangible elements of meaning embodied in the landscape that may not be clearly decipherable through archaeological and ethnohistoric methods. Using a phenomenological approach, Phear (2007) points out Babeldaob's earthworks contain multiple levels of meaning to the society that envisioned, made, used and experienced them. These meanings, ranging from practical, symbolic, experiential and sacred are in a constant process of transformation at perhaps different rates and for different reasons. Understanding the people who built the earthworks and understanding the earthworks is an interrelated and complex process requiring the incorporation of multiple viewpoints of 'landscape.'

2.1.1 A Spatial Scale of Analysis for Earthworks

The scale of analysis is the most effective scale in which patterns can be recognized and meaning can be inferred to identify temporal, spatial and cognitive differences applicable to the research questions (Crumley 1995:2). In this study, the entire island of Babeldaob is the most effective scale for understanding the interrelationship between the development of earthworks and sociopolitical complexity. The scales of analysis decreases in size from the island to the 'earthwork district,' to the 'earthwork complex' to singular earthwork components or features. These scales are used due to the distribution and patterning of Babeldaob's earthworks.

The term 'earthworks' is used interchangeably with 'terraces' and refers to any terrain that is intentionally altered regardless of its dimensions. Terraces shaped into a stairstep pattern are specifically referred to as 'step-terraces.' An 'earthwork complex' is a group of spatially connected earthwork components, each of which is not necessarily of contemporaneous construction or identical in function. An earthwork complex could be a levelled hill with ridgelines and a basin or a low crown with step-terraces separated by gullies (Figure 2 and Figure 3).

On Babeldaob, 'earthwork complexes' are grouped into spatially contiguous clusters of modified terrain. Within these clusters, or 'earthwork districts', the constructed landscape is

generally only broken by streams, basalt outcrops or other physically limiting terrain. Figure 4 is an aerial photograph of a portion of the Aimeliik Earthwork District showing conjoining earthwork complexes. Through distinguishing these clusters (districts) as an analytical unit, the land between each district also becomes part of the analysis because it is not shaped into terraces. This allows for exploring the relationship between the environment the terraced and non-terraced land as part of the larger island landscape.

This thesis does not use a 'site' approach although particular places are examined through data recovery and testing excavations. As Palau's culturally modified topography is spatially contiguous, neither earth features nor complexes lend themselves to being labelled a 'site' as defined by a discrete spatial distribution of artefacts or features (Dunnell 1992:24). In the sense that a visually prominent modified hill is likely a focus of activity, the hill could be a site except that there are no identifiable formal boundaries. The artificially constructed base of the hill will connect to the adjoining constructed terrain. In this sense, earthwork districts do not conform to 'siteless' techniques based on distribution of areas with higher densities of artefacts or features (Dunnell and Dancey 1983)

Babeldaob's place names do not identify terrace structures as a single place or 'site.' Place names instead refer to a natural feature on the topography—a hill, a ridge—or to an oral history that is associated with the area. Due to their large size, an earthwork complex could have several place names, one for each of its component hills, ridgelines, gullies or slopes. Earthworks are identified in this thesis by the most commonly used place name associated with the surrounding topography. If the place name is unknown, the earthwork is labelled with the archaeological site number assigned by the Palau Bureau of Arts and Culture.

2.1.2 Historical Ecology

Historical ecology integrates the methods and theories of the social, physical and biological sciences to explore the complex reciprocal relationship between humans and their environment through the *longue durée* (Crumley 1994, 2007; McGlade 1995; Balée 1998,

2006). Humans are viewed as integral components of the ecosystem with history encompassing the interconnected social and the natural systems.

In this approach, landscapes transform due to the dynamic relationship between changing environmental conditions and human activities (Kirch and Hunt 1997; Kirch 2007). Within the limitations and opportunities inherent to the particular ecosystem they inhabit and their technological ability, individuals chose strategies that mitigated risks and overcame or yielded to vulnerability (Meyer and Crumley 2011:116). These practices are in constant renegotiation in response to the evolving socionatural relationship that is creating, modifying and reconstructing the cultural and natural landscape.

. It is possible that Babeldaob's monumental earthwork landscape was a strategy chosen by the island's early inhabitants to sociopolitically construct the space and place they lived in.

The environment is integral to the economic strategies chosen during the creation and shaping of power relationships (Cliggett and Poole 2008). It is proposed that the construction and use of Babeldaob's monumental earthwork landscape was a key strategy for gaining sociopolitical status and prestige. As this strategy is in particular reference to the local environmental variables the population had to work with, understanding Babeldaob's natural system is integral to exploring the mechanisms behind earthwork construction and use. In turn, this landscape strategy dramatically altered Babeldaob's physical terrain to produce both intended and unintended consequences to the natural system.

2.1.3 Landscape Archaeology in Palau

Due to the extent of Babeldaob's terracing and the current early stage of their analysis, it is almost obligatory to approach earthworks from a landscape or settlement system perspective. Beginning with archaeologists from the Southern Illinois University at Carbondale in 1979, the majority of Babeldaob's earthwork archaeological investigations were conducted at the landscape scale and applied a settlement systems approach (Gumerman et al. 1981; Masse 1989; Snyder 1989).

Wickler's (2002:65) cultural landscape study of terraces and the coastal stonework villages looks at "the role that environmental and social factors played" in the use of the landscape. He regards the landscape as a stage in which socioeconomic activities take place. Liston (2007) and Liston and Tuggle (1998, 2001, 2006) place the interior earthworks into an interpretive framework of a regional settlement model to examine Earthwork Era warfare. Snyder et al. (2011) use a settlement system model to integrate structure and organization with the environment and the ideational. Each of these investigations considered the natural environment as a major factor in human behaviours regarding earthwork use.

To understand the processes and social context of earthwork formation, Phear (2007) applied a post-processual perspective to Babeldaob's earthworks. She emphasized elucidation of the social and environmental contexts that led to their construction from an emic perspective. Ultimately, she was unable to identify the exact significance or meaning of the structures due to the complexities involved in trying to understand the processes and social context in which they were formed. Phear (2007:139) states that it is apparent that the earthworks "had great significance in the creation and perpetuation of significant places, and that the meanings were transformed through processes of construction practices." She concludes that earthworks encompass elements of ritual or sacred importance that were used to formalize the meanings associated with the land and ancestors. Although Phear's proposal aligns with the concepts presented in this thesis, it is, as she concluded, ultimately not archaeologically testable.

2.2 Development of Sociopolitical Complexity

Pacific Island groups developed chiefly levels of sociopolitical organization. These chiefdoms were "regionally organized societies with a centralized decision-making hierarchy coordinating activities among several village communities" (Earle 1987:288, 1991). Although the sanctity of the chiefly position is legitimized by an association with the gods (Kirch 1984), chiefly authority and social ranking is generally derived from ascription accompanied somewhat by accomplishments. Kin-based alliances structure political relations with various

forms of warfare used to expand chiefly influence beyond the hereditary group. The chiefdoms were economically based on differential access to productive resources and moveable wealth.

Archaeologists have long sought to understand the complex processes involved in increasing sociopolitical development and variability in Pacific chiefdoms (Goldman 1955; Sahlins 1958; Earle 1978, 1997; Cordy 1981; Kirch 1984). For Polynesian societies, but probably applicable to most of Oceania, Kirch and Green (2001) propose a shared ancestral social structure of heterarchical household units practicing asymmetrical exchange that are embedded in kin groups with hereditary leadership positions. Once settling in the Pacific islands, these societies retained their common heritage to follow somewhat parallel evolutionary trends. However, alternative pathways were taken to sociopolitical development throughout Oceania. Kirch and Green (2001) identify these various trajectories as stemming from differences in environment, population growth and degree of isolation, and founder effects, among other factors. The different sociopolitical, economic and ideological strategies chosen to acquire power is a significant factor in the variability found in Pacific sociopolitical evolution.

2.2.1 Sources of Power

The acquisition and manipulation of power, primarily economic power, is identified by Earle (1978, 1997) as the principal process in the emergence of hierarchical societies. The elite choose among interlocking ideological, military and economic power sources as leadership strategies to further their own self-interests and legitimize and strengthen their dominant position (Mann 1986; Earle 1987, 1991a). Trajectories of societal development varied in relation to the type and proportion of power sources chosen in leadership strategies.

Military power is a broad category involving competition, forcible control, conflict and rivalry. The ancestral heterarchical social structure of Polynesian groups with asymmetrical exchange systems intrinsically promotes competition and conflict over resources and prestige (Kirch and Green 2001). An important source of power in Oceania chiefdoms is the military strategies chosen by emerging leaders.

Ideology, a source of social power, is established by the strategic creation and manipulation of public expressions of a system of beliefs and ideas (DeMarrais et al. 1996; Earle 1997). The materialization of ideology communicates the degree and nature of social power by embodying both a material and symbolic component (DeMarrais et al. 1996). This takes the form of public ceremonial events, iconography, symbolic objects, the structure of space and monumental architecture. Ideology as esoteric knowledge can also be encoded in myths, symbols and traditional narratives (Rice 2009).

With ideological and military power grounded in the economy, political success ultimately lies in the political economy. Political economy is defined in this thesis as the “material flows of goods and labour through a society, channelled to create wealth and to finance institutions of rule” (Earle 2002:1). Elites become the agency of change by strategically manipulating aspects of the economy for their own economic and political end and by monopolizing the labour of the group (Earle 1987).

Chiefly political economies are based on elements of staple finance, wealth finance and ritual finance (D’Altroy and Earle 1985; Wells 2006; Wells and McAnany 2008). Staple finance involves tribute payments in the form of staple goods or labour. This tribute is used by the elite as revenue to finance ceremonial feasting, warfare, monumental construction and other activities that enhance their authority. Wealth finance takes the form of high-status prestige goods such as exotic trade items, symbolic capital and specialized knowledge that political actors will monopolize by restricting access, controlling exchange or production and limiting distribution. Ritual finance consists of esoteric knowledge, symbols and ritual activities used by the elite to manage and shape belief systems in support of their sociopolitical interests (Wells and McAnany 2008). Analogous to wealth finance, the allocation of ritual finance is also strictly controlled by the elite so that its rarity creates a valuable commodity.

In Pacific Island chiefdoms, Kirch (1984, 1994, 2006) identifies the political economy as largely financed by agricultural production systems. Regardless of the divergences in cultural sequences, the majority of chiefdoms have a political economy that relies on intensification of

agricultural production systems that is overseen by the chiefly class (Firth 1965; Kirch 1984, 2006, 2010; Earle 1997). It is these terrestrial production systems that underlie the power of many of Oceania's chiefdoms.

2.2.2 The Political Economic Strategies of Dual-Processualism

Sociopolitical evolution is often modelled as fuelled by the centralized leadership of emergent political leaders acting in their own benefit. Recent analytical works have sought to minimize the dominance of the elite class in the developmental process and acknowledge the role of non-elite actors in the production of social relations and the emergence of complex societies (Crumley 1995; Feinman 2000a; Pauketat 2007). In these approaches the strategies employed by non-hierarchical institutions and the interactions between differently structured institutions are as important to societal transformations as the actions of the elite (Feinman 1995; Hayden 1995; Blanton et al. 1996; Mills 2000; Bondarenko et al. 2002; Earle 2002; Drennan and Peterson 2006).

The dual-processualism approach used in this research shifts the interpretative focus from development dominated by elite hierarchical structures to recognize the variability in trajectories of social change. Dual-processualism builds on the distinctions previously identified by Renfrew (1974) as individualizing and group-orientated chiefdoms and incorporates elements of heterarchy (Crumley 1987, 1995), bundled continua of variation (de Montmollin 1989), agency (Dobres and Robb 2000) and factionalism (Brumfiel 1994).

Dual-processualism proposes that sociopolitical transformation occurs through political actors choosing within two co-existing political economic strategies to build and legitimize their base of power (Blanton et al. 1996; Feinman 1995, 2000a, b; Blanton 1998). Network political economic strategies focus on personal aggrandization and hierarchical arrangements while corporate strategies emphasize group solidarity through cohesive action. Emerging elites operating in each mode choose different objectives to build, maintain and extend their authority within their particular local conditions (Table 1).

Transformations in these elements reflect changes in leadership strategies. As in factionalism, a significant mechanism of social change is the tension between the different strategies generated by the various scales of authority vying for political power (Blanton et al. 1996; Feinman et al. 2000). Pursuing opposing strategies, community members compete against the dominate political strategy. The alternative paths to sociopolitical development in the dual-processual model is intended to acknowledge the variability inherent to sociopolitical trajectories of change, counteract the bias toward political centralization and focus on behaviour and processes of leadership rather than static developmental stages of social structure.

In corporate strategies, the primary aim is to promote group solidarity and cohesion, restrict exclusionary power and discourage individual prestige. Group solidarity is achieved by suppressing competitive factions and idealizing egalitarian behaviour. Political power is shared through horizontal differentiation of social control and competition (Blanton et al. 1996:6). Integrating mechanisms used to undermine power struggles include membership in crosscutting social institutions, cooperative labour events and communal ritual activities. In the corporate mode, power is attained through inclusion into communal institutions and acquisition of specialized or esoteric knowledge.

The corporate system is characterized as a knowledge-based or staple political economy with institutional ownership of land and control over labour and the local production of subsistence and surplus (Blanton et al. 1996:3; Earle 1997; Feinman 2001:160). The corporate or inclusionary mode relies on symbolic power sources with knowledge, ritual and authoritative resources. Intangible resources that re-affirm the power of the group may include oral histories and myths. Goods flow through the system by means of intergroup reciprocal obligations which can take the form of mobilization of labour. To suppress economic differentiation, exotic or high-status items are equitably distributed.

In network strategies, emphasis is placed on individual leaders and hierarchical arrangements. In exclusionary modes, individuals attempt to develop a centralized decision-

making system that is built around the monopolized control of power sources (Blanton et al. 1996:2). Aspiring leaders use propaganda and manipulation to attract and consolidate a faction of supporters. For example, by hosting large and expensive public events, such as feasts, the elite gain and solidify reciprocal relationships.

The network orientation is characterized as a wealth-based or prestige goods political economy (Blanton et al. 1996:3). The network or exclusionary mode derives power from objective sources such as material wealth and allocative resources. In network strategies, individual political actors and their personal networks compete with each other to control the acquisition, production and distribution of highly valued resources. Differential access to valued items increases, legitimizes and maintains the influence, prestige and power of emerging elites by promoting social inequality, attracting supporters and offering tangible evidence of successful interaction with other groups (Blanton et al. 1996:4).

Despite appearing antagonistic, the two strategies are not a mutually exclusive dichotomy that is entirely independent of one another. Sociopolitical formations can simultaneously employ varying degrees of different elements of both corporate and network modes within different, or each, scale of authority. Corporate interests may be more pervasive at the polity scale while network strategies may dominate the political process at the local or faction scale. Additionally, the corporate-network continuum is not static but changes based on transforming leadership strategies (Blanton et al. 1996).

Dual-processualism is criticized for not providing an avenue to account for why change occurs or what forms the basis for competition and cooperation (Pauketat 2007). The approach is also said to be a restructuring of the same typological debates for stages of cultural change (band, tribe, chiefdom, state) prevalent in archaeology for decades (Pauketat 2007).

2.3 Monumental Architecture as Archaeological Data

Monumental architecture embodies each of the ideological, military and economic power sources. As such, it is often cited as a leadership strategy employed by leaders to define,

legitimize and preserve their prestige and rank in hierarchical social relationships (Renfrew 1983; Kirch 1990a; Trigger 1990; Moore 1996). Reflecting coordinated planning, a large labour force, surplus goods and advanced engineering skills, architecture is a visible and permanent means of ostentatiously exhibiting the wealth and authority of the elite to their subordinates and other political entities. Variability in structural size and elaboration reflects hierarchical patterning with the largest structures associated with the strongest chiefs (Suggs 1961; Kirch 1984; Stevenson 1986; Earle 2002).

As striking public displays, monuments and built landscapes not only identify wealth but impart ideological meanings that can “indoctrinate a population and disseminate propaganda” in multiple ways such as identifying continuity with the past or connecting with the supernatural (Earle 1997:157). By materializing the dominant ideology to transmit it to the populace, the monumental structures politicize the landscape (Smith 2003).

Whether monumental constructs necessarily correlate with sociopolitical complexity is questioned with the possibility presented that they could have arisen through other means (Graves and Ladefoged 1995; Blanton et al. 1996; Feinman 2000a; Joyce 2004; Smailes 2011). Some huge structures developed and grew through the unintended consequences of people originally acting within traditional behavioural structures (Joyce 2004). Joyce (2004) states that the first platforms may have been supra-household spaces built by the community to increase the visibility of and accommodate more participants at feasts, dances, games and other social events. As these practices produced societally beneficial results they were intentionally replicated or expanded upon to ultimately create the monumental structure.

Other researchers show that some large-scale construction efforts do not require a significant logistical, economic or social investment (Muller 1997; Smailes 2011) and could have been executed at the kin-based or village cooperative level (Erickson 1993; 2006; Kolb 1997). Public works such as agricultural, hydraulic or transportation systems that are essential to the general population’s livelihood are more likely to arise from smaller community workforces as personal investments (Lansing 1991; Erickson 2006). Initially centralized

planning generally associated with monumental architecture may not be required due to the accumulation of these public works features over time.

As an expression of political power, massive architecture has a tendency to be used as a leadership strategy in the early stages of hierarchical development when emerging leaders or groups are first establishing their authority to impose their power over others (Stevenson 1986; Kirch 1990a; Bath and Athens 1990; Kolb 1992). According to Knapp (2009:49):

As unequal social systems emerged, with elites seeking to establish their identity and authority, monumental constructions became a prominent and often dominant material feature in the landscape. Once centralised authority became stable, however, elite attention was directed to other aspects of production, consumption and wealth display, all more finite or subtle than monumental architecture. In other words, as the social relations of power changed, so too did the scope and extent of monumental undertakings.

Temporal changes in the dimensions, function, distribution and meaning of monumental architecture can reflect the dynamics of social interactions, specifically competition between the elite (Kolb 1994, 2006; Clark and Martinsson-Wallin 2007; Wallin and Martinsson-Wallin 2011). However, monumental architecture and sociopolitical complexity need not always follow the same developmental trajectories (Sahlins 1958); some transformations can be attributable to changing aesthetic values (van Tilburg 1986) or ideological shifts (Martinsson-Wallin 2000).

In the political economic framework used in many Oceanic evolutionary studies, monumental structures are the manifestation of hierarchical chiefdoms competing for, establishing and maintaining power over subsistence resources (Sahlins 1958; Kirch 1984, 1990a; Graves and Sweeney 1993; Kolb 1994; Earle 1997). The energy invested in monuments maintained the political economy and legitimized sociopolitical success by identifying and showing off ownership or control of the staple finance economy.

Monumental island architecture arises in societies with the ability to successfully exploit their inherently productive and diverse environment with technological advancement (Goldman 1955; Sahlins 1958; Fried 1967). A motivating force in the construction of island monuments is status rivalry as expanding populations claim territorial ownership of highly

productive areas. In Hawai'i, monumental structures track fertile agricultural soils or rich marine resources whose productive potential was enhanced by construction of irrigation systems and fishponds (Kirch 1990a; Kolb 1991). On Rapa Nui, the appearance of ceremonial architecture is linked to successful exploitation of the already available marine and agricultural resources (Stevenson 1986).

In an evolutionary ecological framework, monuments are identified with wasteful or superfluous behaviour (Graves and Sweeney 1993; Aranyosi 1999; Dunnell 1999). Monuments are built in marginal or unpredictable environments where it is advantageous to long-term evolutionary success by generating a reservoir of time, diverting energy from reproduction to reduce the birth rate and warding off or inviting conflict or cooperation (Hunt and Lipo 2001; Shepardson 2006). Monumental architecture is predicted to develop and be densest in these marginal locations where intergroup aggression is more prevalent and where the elite profit from suprapolity integration resulting from this aggression (Ladefoged 1992; Graves and Ladefoged 1995; Aswani and Graves 1998; Field 1998). When productivity increases due to environmental factors or technological changes then it is no longer advantageous to keep populations low and superfluous behaviour such as building monumental structures stops.

Application of political economic and evolutionary ecological theories linking the development of monumental architecture and sociopolitical evolution to either a marginal or a highly productive terrestrial environment is fraught with difficulty on Babeldao. Both approaches could reach the same conclusion. As the majority of Babeldao's acidic soils are unproductive, the monumental landscape and accompanying hierarchical sociopolitical system could be shown to be a consequence of this marginal environment. Conversely, even in such a marginal ecological setting, there are areas with easy access to fresh water sources, the lagoon and arable marshlands. These relatively more productive areas could be archaeologically identified as the key factor correlating the appearance of monumental architecture with the development of sociopolitical complexity. Hence, although the environment and political

economy are fundamental to this thesis, neither of these approaches was tested during the work.

2.3.1 Architectural Correlates of Sociopolitical Organization

Variations in the size, elaboration, spatial organization and relative location of architecture can express social hierarchy (Renfrew 1983; Trigger 1990; Bernardini 2004; Blitz and Livingood 2004). The emergence of and changes to the monumental structures should then reflect differences in political organization and structure. Archaeological studies demonstrate that architectural transformations allow for reconstruction of shifting strategies of sociopolitical power in a dual-processual framework (e.g., Blanton et al. 1996; Trubitt 2000; Vega-Centeno 2010; Englehardt and Nagle 2011; Fargher et al. 2011; Prufer et al. 2011; Kolb 2011).

The architectural correlates of corporate societies are characterized by Englehardt and Nagle (2011:356) as having “greater uniformity and standardization in architectural plans; emphasis on the collective, commercial, and inclusive ritual-religious aspects of architecture; and far fewer restrictions on access to structures.” Whereas the network-based societies “exhibit greater variability in site-planning principles, increased focus on the administrative aspects of architecture, and increased control over access to sites and buildings” (Englehardt and Nagle 2011:356). Table 2 lists some potential architectural correlates of dual-processual strategies in Palau’s Earthwork Era.

Information on the scale of political structure is reflected in the patterned distribution of monumental architecture. Clark and Martinsson-Wallin (2007:31–32) suggest the tight clusters of monumental structures and massive burial mounds in Tonga identify political centralization, dynastic pathways and inter-archipelago or archipelago expansion. In contrast, the reduced clustering and absence of large tombs in Samoa indicates a less centralized political structure with local or regional control.

Despite the skilled artistry and the labour required for the Rapa Nui stone statues, Kolb (2011:143) states their relative ease of construction, lack of relocation after creation and equal distribution across a highly constrained landscape shows that they were built by rival kin groups using corporate power strategies. In time, the monuments became more elaborate and served as boundary markers. This identifies increasing social conflict although possibly not political centralization. Kolb (2011) interprets the eventual shift to use of the *ahu* (stone platform that held the statues) as graveyards as indicative of a breakdown in social cohesion.

Heiau (temples) on Maui display temporal transformations in leadership strategies (Kolb 2011:157). The largest temples were built during the initial political tension that called for corporate group competition to encourage and control social allegiances. After island unification, elite centralization was expressed through network strategies where *heiau* size stabilized and additional *heiau* were built to maintain territorial control and social consensus.

2.4 Summary

A dual-processual model offers an approach to tracing the trajectory of sociopolitical transformations using material remains. The different objectives of each of the political economic modes are associated with particular material and symbolic sources of power that are materialized in the archaeological record. Due to its permanence and prominence, architecture is an ideal medium for examining the different expressions of these leadership strategies. Diachronic changes in sociopolitical organization and social structure should be observable in transformations in the function, dimensions and spatial patterning of architecture

In the development model defined by Kirch and Green (2001), it appears that Pacific societies would gravitate towards network political economic strategies during the processes of sociopolitical change. Evolving from an ancestral group with a social structure that inherently promotes competition accents hierarchical relationships, prestige and material wealth. However, several factors such as a reliance on staple production systems and strong allegiances to kin groups promote corporate leadership strategies.

This thesis examines the trajectory of Palau's sociopolitical development by exploring the role played by the built environment and its transformations within a dual-processual framework. Analysis centres on the processes involved in choosing monumental earthworks as political economic strategies rather than just the correlation of architecture with network and corporate modes. Pacific Island chiefdoms, as evidenced by monumental architecture, appear after several millennium of island occupation, relatively late in the developmental process. The early appearance of monumental structures on Babeldaob, within a millennium after island settlement, provides a unique opportunity to formulate a long-term sociopolitical development model of a Pacific island chiefdom.

3.0 ENVIRONMENTAL AND CULTURAL CONTEXT

The Republic of Palau is the westernmost archipelago in the Western Caroline Islands of Micronesia. Centred at 7°30' north, 133°30' east, the archipelago of over 380 islands stretches along a 700 km long north to southwest-trending arc. The north 150 km of the arc, from Kayangel to Angaur, contains the main bulk (414 km²) of the islands.

The study area is the volcanic island of Babeldaob which, with a land mass of 313 km², accounts for about 78 percent of Palau's land area and is the second largest island in the Western Pacific (Corwin et al. 1956). Palau's remaining landforms are platform like reef islands, atolls and tectonically uplifted, small coralline limestone islands, locally referred to as the "Rock Islands." The Southwest Islands—an isolated cluster of five low coral islets and an atoll—lie between 340 and 600 km southwest of the remainder of the archipelago and are less than 200 km north of Indonesia. Palau's 525 km² of barrier, fringing, and patch reef systems enclose the main body of islands creating an over 1200 km² and up to 50 m deep lagoon (Maragos et al. 1994).

Modern Palau is politically divided into 16 states, composed of traditional village areas¹, each with several traditional (stonework) villages (Figure 1). Koror, on the small island of Oreor immediately south of Babeldaob, is Palau's industrial and commercial centre and, with about 13,000 people, houses close to 75 percent of the population. Most of the remaining population is dispersed throughout coastal villages on Babeldaob. The Rock Islands, dotted with ancient stonework villages, are currently uninhabited.

3.1 Babeldaob Island

Babeldaob contains the majority of Palau's earthwork complexes with other earth structures sculpted into the volcanic portions of the three small islands of Oreor,

¹ Archaeological village area refers to the land, lagoon and subordinate villages around a principal village that is controlled by the village chiefs. Although still acknowledged by the local population, the principal village may now be abandoned and the chiefs may reside elsewhere. In the past, the boundaries of village areas probably changed through time due to warfare, alliances and other mechanisms.

Ngerekebesang and Malakal. At 42 km long and from 0.5 to 13.0 km wide, there is no place on Babeldaob further than six to seven kilometres from the coast.

Located on the western edge of the Philippine tectonic plate, the islands are part of the Palau ridge crest, one of a series of arcuate volcanic ridges separating the Philippine Sea and the Pacific Ocean basins. Just on west side of Andesite Line, Babeldaob is divided into three volcanic units dating from the late Eocene through the early Miocene (Corwin et al. 1956; Hawkins and Ishizuka 2009; Figure 5). The volcanic basement is principally composed of massive basaltic-andesitic, volcanic breccia, and some tuff breccia and layers of interbedded tuff. Dacite and diorite are also found in the substrate.

Three low ridge systems split Babeldaob's along its north-south axis with the largest of these, the Rael Kedam, extending the central length of the island. Rising to a maximum elevation of 213 m amsl at Ngerchelechuus, this central mountain area has weathered into well-rounded peaks and small, steep-sided valley systems with narrow ridges (Figure 6; Figure 7). This change in elevation is not enough to cause a significant orographic lift. Circling the uplands are lowland hills feeding out to coastal plains formed from the thick clay deposits of the weathered andesite, basalt and dacite. The low undulating terrain is interspersed with limited marine terraces and marshes.

The island maintains a complex network of 555 km of perennial streams and rivers in dendritic drainageways forming five major watersheds: the Ngeremeduu, Ngerdorch, Ngerikiil, Diongradid and Ngerbekuu (Figure 8, Table 3). At ca. 80 km², the Ngeremeduu watershed is the largest in Palau. Its primary river, the Ngermeskang, drains into the 15 km² Ngeremeduu Bay, Micronesia's largest estuary. Babeldaob's other large bays include Ngerchemiangl and Ngerikiil/Airai Bays. Because the bays are protected from oceanic storms and have restricted water circulation, they do not experience significant flushing from wave energy. Babeldaob supports only two natural freshwater lakes of any size. Melekeok's Lake Ngerdok is about 11 ha and has a depth of about 2.7 m, and Ngaraard's Ngerkall Pond has a surface area of ca. 0.4 ha and is less than a meter deep.

3.2 Long-Term Transformations to Babeldaob's Coastline

Babeldaob's coastal geomorphology is dramatically different from that at colonization due to changes in sea level, island subsidence and both natural and anthropogenic erosion. Currently, the steeply sloped low bench constricting the majority of the coastal margin falls to generally wide spans of mangrove forests enclosing 125 km (80 percent) of Babeldaob's coastline. Artificially enhanced channels (*taoch*) lead from the mouths of river, streams and other coastal areas through the mangrove to the lagoon. Only on the northeast where the fringing reef is closer to the island's coast is there a narrow lengthy strip of sandy beach.

3.2.1 Sea Level and Tectonic Activity

Following Mitrovica and Peltier (1991:Figure 9a), Dickinson and Athens (2007) identify a ca. 1.5 m draw-down in Palau's sea level since the peak of the mid-Holocene highstand. Based on variations in mangrove pollen counts in littoral wetland cores, Athens and Ward (2005) suggest Palau's highstand conditions began about 5000 calBP with significant drawdown starting after 2500 calBP and persisting until about 800 calBP (Dickinson and Athens 2007:182–183; Athens and Stevenson 2011:221).

At about 800 BP, when the drawdown may have ended, Nunn (2000a, 2003, 2007a, 2011) proposes that the majority of the Pacific Basin experienced a ca. 50 to 80 cm drop in sea level and a stormier period. This is caused by rapidly cooling temperatures during the "AD 1300 Event," a perceived pan-Pacific "environmental catastrophe" which Nunn models as having occurred between AD 1270 and 1475 that represents the transition from the Medieval Warm Period (MWP, AD 800–1300) to the Little Ice Age (LIA, AD 1400–1800). Within this 200 year time span Nunn has identified two separate periods of environmental flux involving a decrease in temperatures, the lowering of sea level, increased storminess and a short-lived rise in precipitation. Stage 1 is modelled to have occurred between AD 1270 and 1325, while Stage 2 extends from AD 1455–1475. The lack of direct evidence of Nunn's "AD 1300 Event" in Palau does not discount long-term shifts in temperature, rainfall and sea level that significantly

impact Palau's settlement systems, subsistence economy and sociopolitical organization (Masse et al. 2006; Fitzpatrick 2010, 2011; Clark and Reepmeyer 2012).

Analysis of paleoenvironmental cores recovered from Palau's coral reefs suggest to Easton and Ku (1980; Kayanne et al. 2002) uplift varying from about 0.8 m on the Rock Islands during the past 2,900 years to 2.0 m on Babeldaob and Oreor in the last 4,000 years. In contrast, Dickinson and Athens's (2007) analysis of these same reef cores and those collected in Babeldaob's coastal wetlands (Athens and Ward 2005) demonstrate Babeldaob subsided at a mean rate of about 0.55 mm/year throughout the Holocene. This equates to a subsidence rate of ca. 55 cm per millennium or about 1.65 m in the past 3,000 years. Although it does appear that Babeldaob is subsiding, highly accurate determinations of paleocore elevations are needed before such an infinitesimal subsidence rate can be assigned.

3.2.2 Erosion and Sedimentation

Erosion and sedimentation have dramatically impacted Babeldaob's coastal margin since colonization. Formed in saprolite derived from volcanic rock, Babeldaob's volcanic soils are generally very deep, well drained and fine textured silty clays that rapidly become saturated and are susceptible to erosion and landslides. Without the benefit of protective vegetative cover in the heavy tropical rains and on generally moderately to steeply sloped terrain these clayey soils are particularly vulnerable to erosion and mass wasting. Rather than maintaining groundwater, 70 percent of the rainfall that is not lost through transpiration or evaporation flows to the shoreline carrying erosional sediments with it (Van der Brug 1984:31). Because the shallow lagoon protects Babeldaob's coast from oceanic storms and restricts water circulation, there is not significant flushing from wave energy and the eroded sediments are retained close to the coastal margin and riverbanks.

These natural processes of soil erosion, mass wasting and sedimentation are triggered or vastly accelerated by anthropogenic activities. Golbuu et al. (2003) found that only one percent of the terrigenous material flowing into Airai Bay reaches the ocean while an estimated 30 percent is trapped in the mangroves and 69 percent is deposited in the bay. Human

development activities, rather than geomorphology and hydrodynamics, are the largest factor influencing the quantity of sediment entering Babeldaob's rivers and bays (Golbuu et al. 2011).

Before human colonization, when Babeldaob was heavily forested, vegetation protected the soil from rainfall and runoff. Significant and sustained downslope deposition of sediment likely first occurred during forest clearance for swidden cultivation. Earthwork construction and use enormously increased the influx of upland sediments into the lowlands, drainages and lagoon. Several of Babeldaob's paleocores reveal abrupt transitions and thick deposits of upland colluvial material onto lowland sediments at about 2500 calBP coinciding with archaeological dates of initial interior earthwork construction (Athens and Ward 2005; Liston 2009; Athens and Stevenson 2011). Due to edaphic conditions and the sustained period of intensive interior land use, Babeldaob's ancient erosion likely far exceeds the million cubic meters of sediment deposition that Kirch and Yen (1982:329) estimate resulted from early settlers burning vegetation on Tikopia's slopes.

The erosion and sedimentation generated by deforestation and earthwork construction and use is largely responsible for the extension of the coastal margin, growth of the mangrove habitat and formation of saturated bottomland soils (Athens and Ward 2005; Liston and Tuggle 2006; Liston 2007a). These deposited soils are found in freshwater environs, swamps and flood plains along the larger streams and in the brackish water of the intertidal zone. Eventually the eroded material develops into highly fertile hydromorphic soils conducive to pondfield cultivation (Kubary 1895; Barrau 1961; Hunter-Anderson 1991; Athens and Ward 2005; Liston 2007a).

3.3 Climate and Climate Variability

Palau has a tropical maritime climate with slight seasonal variations. The mean annual temperature is 27.6°C with an average relative humidity of about 87 percent. Palau has moderate levels of sunshine with Koror having a 30-year average of 6.5 cloudless, 79.3 partially cloudy and 275.6 cloudy days per year (Gavenda et al. 2005:16).

Annual precipitation averages about 360 cm, although this can vary widely. In 2011 anchoring of the monsoon trough close to Palau caused a record high annual rainfall of 523 cm (NOAA 2012). The lowest precipitation occurs from February through April with an average of 200 to 230 cm of rainfall each month and the highest is in July with an average of 440 cm of rain (Van der Brug 1984:23). Most precipitation occurs in the form of short torrential storms. At the southern margin of the western Pacific typhoon corridor, Palau is rarely struck full force by a major storm. The archipelago is not immune to severe typhoons as at least twelve damaging typhoons struck the islands since the mid-nineteenth century (Kubary 1895; Krämer (1917-1929, in Van der Brug 1984:11–12).

The primary source of Palau's fresh drinking water is rainfall. Due to only moderately permeable soils, 70 percent of rainfall flows out to the lagoon rather than being maintained as groundwater (Van der Brug 1984:31). Van der Brug (1984:31) calculates Babeldaob's waterways discharge ca. 275 billion gallons of freshwater annually.

The most pronounced seasonal climatic change is the shift in prevailing surface winds that affects rainfall, humidity, tides, currents, sea swells and marine life (Johannes 1981; Masse 1989). Prevailing trade winds averaging 13 km/hour originate from the northeast from November to May and from the south to southwest from June to October (NRCS 2010:10). According to Masse et al. (2006:109):

During the westerlies Babeldaob's west coast is buffeted by strong winds and pounded by large swells and breakers, making fishing difficult and boat travel hazardous while the east coast is relatively protected. These conditions reverse during the northeasterlies. Johannes (1981) found a correlation between peak spawning periods in many reef fishes and the change between the seasons when prevailing winds and currents are at their weakest.

Orographic lift appears to play an insignificant role in Babeldaob's weather. Differences in the island's wind patterns due to hills blocking and deflecting airflow and land-sea wind interactions are noted but poorly understood (Wolanski and Furukawa 2007). Historical data suggests rainfall variations across Babeldaob (Van der Burg 1984:18; Gavenda et al. 2005:15), although Golbuu et al. (2011) calculate no significant differences. Variation in intensity of precipitation is likely as Palauans perceive Aimeliik as receiving more rain, a recognition that

is incorporated into the oral history. After being slain, the body of the giant Chuab toppled over and created Babeldaob. Parts of the giant's anatomy formed different island districts—Ngarchelong, the northernmost district, is the head of Chuab. Aimeliik, in Babeldaob's southwest corner, is Chuab's genitals and thus has the most rainfall.

With surface water temperatures generally ranging between 27.5° and 30.0°C (Colin 2009:17), Palau is in the Western Pacific Warm Pool and within the Inter-Tropical Convergence Zone (ITCZ; Gagan et al. 2004; Oppo et al. 2009). The El Niño/Southern Oscillation (ENSO) and the inter-related changes in the ITCZ significantly impact Palau's climate and weather. In El Niño events Palau experiences cooler, drier conditions and in La Niña events warmer, wetter conditions with higher storm frequency.

Significant El Niño associated droughts are calculated to occur on Palau at an interval of every 125 years (Van der Brug 1986:23), although this span appears to be significantly shortening. The last aggressive ENSO event in Palau was in 1997–1998 when air temperature warmed by 1.5°C, compared to the usual El Niño associated increase of 0.25°C (Bruno et al. 2001).

Precipitation anomalies associated with moderate to strong El Niño events between 1900 and 1998 identify Palau as in the area experiencing the greatest deficit of annual rainfall, a loss of more than 20 cm or about six percent (Gagan et al. 2004:Fig. 5). A substantially greater fall in precipitation is identified by AusAid (2006:22) who document a typical 20 percent drop (ca. 70 cm) during the mature stage of an El Niño event. A 30 percent (ca. 110 cm) drop in rainfall, with streamflow falling to 16 to 20 percent below normal, was recorded in Palau for the first five months of 1983 during what is considered the strongest Western Pacific El Niño event in 100 years (Van der Brug 1986:29). Van der Brug (1986) notes that the most severe effects of the 1982–1983 drought were felt on islanders, such as Palauans, who rely on surface water for their water supply and normally experience seasonal periods of dry weather.

Reconstruction of climatic variability in the Pacific indicates that Palau's climate was comparatively dryer from about 550–300 BP due to the shifting ITCZ (Sachs et al. 2009;

Smittenberg et al. 2011). Concurrent with these changes in precipitation were the increasing frequency of El Niño events in the final years of the MWP (Gagan et al. 2004) that could have resulted in more frequent droughts in the western Pacific.

The small karstic Rock Islands with little soil for gardening and a reliance on rain catchments and the Ghyben-Herzberg aquifer for potable water are more susceptible to climatic fluctuations than the larger island of Babeldaob (O'Reilly 2010; Clark and Reepmeyer 2012). Clark and Reepmeyer (2012) note the abandonment of the Rock Islands recorded in Palau's oral history could conceivably coincide with the low rainfall documented in the paleoprecipitation studies (Sachs et al. 2009; Smittenberg et al. 2011) and hence could be linked to LIA climate change. Neither Athens and Ward (2002, 2005) nor Athens and Stevenson (2011) identified any sedimentary unconformities or pollen disturbance indicators in their near coastal cores that are coincident with the LIA.

3.4 Volcanic Soil and Fertility

Soil pH for optimum plant growth is between 5.5 and 7.0 while soils with a pH in water of less than 5.5 dramatically reduce soil fertility. Due to weathering of volcanic soils, these acidic soils are commonly found on Oceanic islands (Table 4; Morrison 1988). Of all the Pacific's volcanic islands, Babeldaob contains the most infertile soils per land area. Covering over 80 percent of Babeldaob is acidic topsoil, with an average pH of 4.9 in the fern and grassland and 5.3 in the forest. These volcanic soils have very low native fertility due to low nutrient reserves, high phosphorus retention and low cation exchange capacity (CEC).

In addition to these volcanic upland soils, all oxisols, Babeldaob contains limited amounts of bottomlands, marine terraces, calcareous sand and limestone outcrop (NRCS 2010; Figure 9; Table 5). Babeldaob's limestone landscape is limited to the southern tip of the island, with coral sand atoll category only found in the southeast and in sparse patches up the east coast. The chemical and physical properties of Babeldaob's most common soil series are tabulated in Table 6. Table 7 presents the soil property ranges for the topsoil and subsoil of Babeldaob's major soil groups.

Volcanic uplands soils are composed of the Aimeliik-Palau, Babelthuap-Ngardmau-Udorthents, Udorthents-Urban Land and Ollei-Nekken map units dominated by the Aimeliik, Palau, Babelthuap and Ngardmau series (NRCS 2010). Decomposing plant material in the ca. ≤ 8 cm thick fragile topsoil of the Aimeliik-Palau map unit provides most of the nutrients needed for crops to thrive.

The Aimeliik series soils are forested and the most fertile of the volcanic soils. As shown in Table 7, once the forest is removed the nutrient cycle is disrupted and the soil organic matter (SOM), containing most of the CEC, is reduced by almost half. Removal of organic matter also allows for depletion of nutrients from topsoil through leaching and erosion. In addition to washing away the thin layer of fertile topsoil, upland erosion also increases siltation to detrimentally impact surface water and the marine environment (Golbuu et al. 2003, 2011). The Palau series has lower organic matter that can only support savannah grasses and ferns. Further soil degradation is seen in the Babelthuap and Ngardmau soils which have no effective nutrient cycling and low biomass accumulation and are so degraded they support minimal vegetation.

3.5 Resources and Vegetation at Settlement

As in Hawai'i, the Solomon Islands, Rapa Nui and other Pacific Islands (Flenley 1994; Athens et al. 2002; Bayliss-Smith et al. 2003), paleoenvironmental, archaeological, botanical and remote sensing studies demonstrate ancient and historic activities have radically altered island floristics (Athens and Ward 2005; Kitalong 2008; Costion et al. 2012). Palau's ancient and historic settlers changed the distribution, composition and relative abundance of biotic communities by intentionally or inadvertently introducing useful and invasive species; expanding, restricting and destroying habitat; and cultivating economically or ritually useful plants. Palau's past vegetation communities and their transformations have been partially reconstructed by pollen sequences and plant macrofossils identified in wetland paleoenvironmental cores (Athens and Ward 2002, 2005; Athens and Stevenson 2011).

Babeldaob's acidic soils severely limit the recovery of archeobotanical and midden remains. The few midden deposits encountered in Babeldaob's oxisols are so differentially preserved that they present an incomplete and skewed picture of the resources being exploited.² Reconstruction of subsistence regimes relies largely on wetland coring records and Rock Island midden deposits. However, principally due to environmental conditions, traditional populations in the volcanic and karstic islands practiced different subsistence strategies (Clark and Reepmeyer 2012). The flora and the variety of marine, avian and mammalian species consumed by early Palauans on the Rock Islands does not necessarily reflect the subsistence strategies employed by the entire archipelago.

3.5.1 Vegetation Regimes

Palau's flora derives largely from the East Asian and Indo-Malesian region (Mueller-Dombois and Fosberg 1998). Classified as lowland tropical rainforest, Babeldaob displays seven broad land cover categories (Cole et al. 1987; Table 8; Figure 10). Currently, the majority of the island is covered in dense strands of volcanic upland forest (60.4%) followed by grassland (18.3%) and mangrove forest (11.0%). Swamp forest (4.4%), fresh water and cultivated marsh (1.5%), and agricultural land (3.2%) are also found on Babeldaob. Barren land (0.4%), urban land (0.4%) and Rock Island forest (0.3%) make up a very small part of the land cover. Plants common to each of the largest five categories are listed in Table 9.

Prior to human settlement, Micronesia's savannah vegetation was restricted in extent, possibly associated with outcrops or the volcanic slopes of the Mariana Islands (Mueller-Dombois and Fosberg 1998; Manner et al. 1999). Paleocore data shows that Babeldaob was a mostly forested landscape before human colonization (Smith and Babik 1988; Athens and Ward 2005). The island was largely deforested due to swidden cultivation, by providing firewood and construction materials and in clearing space for villages, lines of sight, activity areas, lookout points and ceremonial or ritual sites. The paleoenvironmental record documents

² Degradation of perishable materials is of such magnitude that Pregill and Steadman (2000:138) claim that the "scarcity of rich, fossiliferous sediment in Palau is thus far unequalled for tropical Pacific islands."

an alternating pattern of deforestation and forest regrowth that parallels the extent of interior use by Palau's early populations (Athens and Ward 2005; Liston 2007a, 2009).

The almost complete absence of taxonomic evidence for species endemic to Babeldaob's savannah and marshes supports the relatively recent formation of these habitats (Costion et al. 2012). This concurs with the proposition that ancient human land use produced the vast majority of Palau's grasslands. The well-developed mangrove forests currently lining the lower portions of rivers and the coastal intertidal areas also significantly expanded after colonization (Figure 11) due to the dramatic increase in siltation caused by ancient forest clearance and earthwork construction. Changes in sea level and island subsidence also contributed to the abundance of Babeldaob's mangrove forest.

In reconstructing Palau's paleoenvironment, Athens and Ward (2005) identify several unknown pollen types that rapidly decrease following human colonization. Some of these unknown plant species disappear entirely, especially between ca. 2000 and 1500 calBP. As Babeldaob's acidic soils are not conducive to the preservation of skeletal and archeobotanical remains, the extent and nature of the post-settlement extinction or extirpation of some of Palau's floral and faunal species will likely never be recognized.

3.5.2 Protein Resources

Few terrestrial animals contributed significantly to the traditional diet. Keate (1788) and Kubary's (1892) inventory of terrestrial protein sources is limited to crabs and a few birds. As on other Pacific Islands, avian species may have once been abundant before being dramatically reduced and hunted to extinction after human settlement (Steadman 2006). With limited data, Masse et al. (2006:120–121) suggest that the pig (*Sus scrofa*) was once common in Palau but was extirpated before Western contact (see Reith 2011).

Lacking terrestrial sources of animal protein, most of the protein food supply was procured from the exploitation of littoral and marine resources in the sheltered lagoon and productive reefs. A few of the common fish families unearthed in archaeological midden

include parrotfish and wrasse (Labridae), snapper (Lutjanidae), emperor (Lethrinidae), bream (Nemipteridae) and sea bass (Serranidae) (Masse 1989; Fitzpatrick and Kataoka 2005; Ono and Clark 2011). Some of the most common recovered shellfish species are *Anadara*, *Atactodea*, *Conus*, *Fragum*, *Hippopus*, *Nerita*, *Strombus*, *Tridacna* and *Turbo* (Carucci 1992; Fitzpatrick 2003; Wright 2005).

3.5.3 Plant Resources

Micronesia's paleoecological records identify the region's abundant and diverse native flora that provided a wide range of exploitable resources to the first settlers. Wetland cores from Palau, the Mariana Islands and Kosrae identify coconut (*lius*, *Cocos nucifera*) as established before the arrival of humans (Athens et al. 1996; Athens and Ward 2004, 2005). Giant swamp taro (*brak*, *Cyrtosperma merkusii*), once considered an introduced cultigen (Fosberg et al. 1987; Yen 1991), was recently identified in paleocores collected in Palau and Pohnpei that date to the middle and early Holocene, long before colonization (Athens and Ward 2001; Athens and Stevenson 2012). Betel nut palm (*buuch*, *Areca catechu*), first appearing in Palau's pollen sequence at ca. 5000 calBP (Athens and Ward 2005), could be an introduction, however, it is more likely a native species as it is on Guam (Athens and Ward 2004).

Other edible native plants available to Palau's colonizers include wild native breadfruit (*meduu liou*, *Artocarpus mariannensis*), *Pandanus tectorius* (*ongor*), the tropical almond (*miich*, *Terminalia catappa*) and the Tahitian chestnut (*keam*, *Inocarpus fagifer*). Although an edible variety of wild yam (*Dioscorea flabellifolia*) was likely present before colonization, yams have not been identified in Palau's early botanical or charcoal record nor is there archaeological evidence (e.g., mounds, ridges) of early yam cultivation. Recorded as one of the main subsistence crops in nearby Yap and Guam in the eighteenth century (Le Gobien, in Barrau 1961), edible yams were present but not cultivated or listed as a Palauan food source in the late 1800s (Kubary 1892:162). If not domesticated on Palau, Yapese voyagers may have

introduced domesticated yams although they may have never been a popular food source (McKnight and Obak 1959:29).

Colonizers introduced cultigens and other economically useful plants from their homelands. Of Palau's close to 1400 documented vascular plant species, ca. 135 are endemic and at least 571 are introduced (Costion et al. 2009; Costion and Lorence 2012). The most significant early introduced food crop, and likely a dominant staple since colonization, is the true taro (*kukau*, *Colocasia esculenta*), already domesticated in the Indo-Malayan region. Species of edible banana (*Musa* spp.) and domesticated breadfruit (*meduu*, *Artocarpus altilis*) likely originated in New Guinea (Latinis 2000; De Langhe et al. 2009; Zerega et al. 2004) before being introduced to Palau.

Paleocores document *Artocarpus* pollen as being "continuously present in some quantity" after 2400 calBP (Athens and Ward 2002:57). Currently of little dietary importance, breadfruit may have made a significant contribution to the early Palauan subsistence economy, despite being only seasonally productive. Liberally scattered throughout Babeldaob's lowlands hills are large pit features that may identify ancient breadfruit fermenting/preserving pits like those observed by Krämer (1926) at the turn of the nineteenth century. Its contribution to the food supply may have been of particular importance on the Rock Islands where *A. mariannensis* is commonly found. Breadfruit appears in one of Palau's most well known myths and "*meduu*" is a common component in Palauan place names, particularly those associated with interior hills.

Other cultigens, edible resources and useful plants appearing in archaeological deposits early in Palau's cultural sequence (before 1800 years ago) include gourds, the Malay apple (*kidel*, *Syzygium malaccense*), *Manilkara udoido* (*uduid*), *Diospyros ferrea*, *Calophyllum inophyllum* (*btaches*), *Canarium hirsutum* (*mesecheues*), *Casuarina equisetifolia* (*ngas*), *Macaranga carolinensis* (*bedel*) and possibly an edible species of *Bruguiera*. Rice (*Oryza sativa*), introduced from Southeast Asia, was grown in Guam before Western contact (Yawata 1963; Hunter-Anderson et al. 1995). Currently there is no evidence of its ancient introduction to Palau.

For as long as can be remembered, the true wetland taro (*kukau*, *C. esculenta*) has been Palau's dietary staple crop and is referred to in Palau as the Mother of Life. Grown in elaborate irrigated pondfields (*mesei*), *kukau* plays a vital part in the economic, social and ceremonial aspects of Palauan culture (McKnight and Obak 1960; McCutcheon 1981). The cultivation, harvesting and preparation of *kukau* is the role of women with their reputation reliant on the successful production and quality of her pondfields.

3.6 Earthworks in Tradition and Archaeology

Palau's traditional narratives are conspicuously devoid of direct reference to the extensive clusters of earth architecture that dominate Babeldaob's topography. The timing and function of these earthworks is in the domain of anthropological archaeologists who first began documenting them in the 1920s. Only in the last decade has sufficient archaeological data been collected to begin more accurate interpretations and the formulation of developmental models.

3.6.1 Indigenous Perspectives and Ethnohistoric Accounts

Palau's ethnographic accounts do not mention the desolate terraced hills in the largely unoccupied interior (Keate 1788; Hockin 1803) and most Palauans do not conceive of them as artificially constructed. Cheyne, an English trader in Palau in the mid-1800s, is the first to document earthworks, noting that Palauans did not recognize them as their own constructs (in Parmentier 1987:30):

All the hills of the Pelew Islands that are clear of timber are terraced and crowned with a square fort, having a deep and wide ditch round it, evidently done by the hands of another race – probably Chinese – long ago exterminated by the savage invaders who now occupy the soil. The Pelew Islanders when questioned about the terraced hills and forts say it was either done by the gods or by the sea at the flood.

When the German ethnographer Krämer (1919:238–239) asked about terraces, the local population denied that “the shape of the mountain is the result of artificial construction,” instead saying that the terraces were “what remained after the great flood.” Many elders still consider the flood, referring to Palau's creation myth, to have formed the terraced hills (Tellei et al. 1998a:106). Other contemporary elders claim the earthworks are the remains of ‘those

who came before' (*tirkel di mla chad*), the first wave of migrants who have no relationship to them and either left the islands before their own ancestors arrived or were annihilated in the great flood (Tellei et al. 1998b:240).³ A few stories recount a mystical time where terraces are depicted as steps linking the gods to heaven and earth.

In the 1920s, Japanese anthropologist Hijikata (1995:70) notes that, despite not being part of daily life and found in impractical locations removed from the then inhabited villages, earthworks:

do not seem to be treated irrelevantly either. Rather, it [earthworks] was taken care of and treated with consideration. Therefore, this was something reserved for religious beliefs . . .

Palau's language and iconography do not allude to a past connection with earthworks. The Palauan term for earthwork, *oublallang el bukl* (stepped hills), is a recent and little used addition to the language (R. Olsudong, pers. communication), while names for ditches, both transverse (*klaidebangel* 'hole dug as a trap') and lateral (*chomedoilmach*, *omdok uach* 'to catch a foot') appear to have long been used (Osborne 1966:232; Basilius 2002:143). During Krämer's (1917:261) visit, Palauans referred to the shaped mountains as *deleuechel* (steps cut into a coconut tree) and the hilltops as *telongeklel* (the heights). The words commonly used in describing Babeldaob's topography—*rois* (mountain), *bukl* (hill) and *ked* (savannah)—are not references to artificial constructs.

Earthworks are not among the legends, historic events and significant symbols decorating the beams of each stonework village's *bai era rubak* (chiefly meeting hall) that were meticulously copied by Elizabeth Krämer (in Krämer 1929) in 1909 and Hijikata (1996) in the late 1920s.

With many locations identified in Palau's oral narratives only recently recognized as earthwork constructions, Liston and Miko (2011) questioned why such massive and extensive complexes are largely excluded from Palau's traditional narratives. Their review of the

³ There is no archaeological, linguistic or genetic evidence suggesting that an earlier population was replaced by a later arriving group.

ethnohistoric literature and oral history documentation in conjunction with the archaeological record found that, contrary to historic perceptions, the narratives contain a substantial though indirect reference to terrace complexes.

3.6.2 Archaeological Perspectives

Documentation of Palau's modified terrain in anthropological literature started with the drawings and observations of the Japanese anthropologist Hijikata (1993, 1995) in the 1920s. Archaeological investigations of Babeldaob's earthworks began in earnest in the 1960s with substantial survey and some excavation by Osborne (1966, 1979). Beginning in 1979, archaeologists from the Southern Illinois University at Carbondale conducted some surveys of Babeldaob accompanied by much more detailed work in the Rock Islands within a settlement system approach (Gumerman et al. 1981; Masse 1989; Snyder 1989; Carucci 1992). Dissertations by Lucking (1984) and Phear (2007) focused on earthworks. The former attempted to identify step-terraces as dryland taro cultivation systems and the latter tried to elucidate the social and environmental contexts that led to earthwork construction within an emic perspective.

The majority of earthwork investigations have been conducted since the mid-1990s in conjunction with U.S. funded development projects that required compliance with historic preservation laws. The most significant of these is the decade long, multi-phase Compact Road investigations (Athens and Ward 2005; Tellei et al. 2005; Wickler et al. 2005; Liston 2007a, 2011a; Athens and Stevenson 2011; Tuggle et al. 2011).

With limited inland archaeological data, Palau's early earthwork studies integrated the structures into largely speculative relative chronologies and inferred earthwork function almost solely by morphological analogy (Yamata 1930; Osborne 1966, 1979; Lucking 1984; Masse et al. 1984; Morgan 1988). Most scholars concluded that the primary function of terraces was agricultural with defence the function most commonly attributed to the crown and ditch complexes (Osborne 1966, 1979; Butler 1984; Lucking 1984; Masse et al. 1984; Gumerman 1986; Phear et al. 2003; Snyder et al. 2011). At the same time, variations in morphology

suggested a number of auxiliary functions including ceremonial activities (Hijikata 1995), habitation (Osborne 1979) and water control (Lucking 1984:162–164; Snyder et al. 2011:174).

These archaeologists propose earthworks are associated with agricultural development and defensive posturing. In general, they suggest that the most significant mechanism behind terrace construction is competition for resources due to demographic pressures that led to agricultural intensification accompanied by warfare. The terraces are evidence of a strong local aristocracy and the development of sociopolitical complexity (Osborne 1966). Their abandonment is suggested to coincide with disease, conflict or cultural decay some of which may have been precipitated by exhaustion of the terrace soils (Osborne 1966; Lucking 1984).

Extensive excavation and survey on Babeldaob allowed Liston (2007a, 2009, 2011a) and Liston and Tuggle (1998, 2001, 2006) to verify many of the previously suggested terrace uses, extend and substantially revise the earthwork chronology and propose a preliminary model of earthwork function and their abandonment. Liston (2007a:351–359, 2011a:467–469) attributed the principal use of low step-terraces as agricultural and the primary function of the earthworks as a whole as a multi-faceted symbol of polity power. A contemporaneous and integrated system of terrace usage was in effect from the onset of their construction with additional earthwork uses including habitation, foundations for ritual and ceremonial activities, burial and a broadly defined defensive use.

After placing the earthworks into an interpretive framework of a regional settlement model, Liston and Tuggle (2001, 2006) propose that the bulk of community activities took place on the earth structures, with the clusters defining small-fortified polities. The construction of defensive features, establishment of territories and symbolic displays of wealth is a response to competition for critical subsistence resources.

Although without explicitly stating so, the majority of Palau's archaeological earthwork investigations were conducted at the landscape scale. Researchers applied a settlement systems approach within a political economic framework to form evolutionary models of earthwork development. This is largely due to the extent of terracing calling for broad scale

investigations and the strong yet improvable assumption that step-terraces supported the early terrestrial subsistence economy. Like many studies of terracing or monumental constructions in Oceania, the natural environment is often posited to play a key role in the development of the sociopolitical system during the period of earthwork use.

3.7 Summary: A Socionatural Landscape

Environmental variables play a key role in the development of Oceanic complexity as settlers chose strategies to adapt to the natural resources in their new homes. In part this is due to island circumscription limiting the opportunities for territorial expansion once maximum carrying capacity is reached (Carneiro 1970; Hommon 1976; Kirch and Green 2001). This affects the potential for the generation and extraction of surplus upon which emerging leaders depend (Earle 1991a:10–11). Equally important are the environmental properties and conditions that are available for exploitation by island settlers.

This review of Palau's environmental and cultural background with relevance to the period of sustained terrace construction and use provides a context for understanding the relationship between the evolution of the natural landscape, the emergence of a monumental earthwork landscape and the development of sociopolitical complexity. The behavioural strategies chosen were influenced by the natural environment and, in turn, these strategies affected the environment.

With very little island-wide variability in weather, the most significant difference is the seasonal wind patterns that affect lagoonal transportation and the availability of marine resources. Palau is severely affected by climate perturbations but with the current paleoclimate data extending back less than a millennium, the impact climate variability had on Earthwork Era populations and societal development can not be assessed.

The immediately distinctive natural condition that has the potential to impact human activity is the highly weathered acidic volcanic soils covering over 80 percent of Babeldaob. This is far more acidic soil per land area than found in any other Pacific Island group. These

soils contain very low native fertility and are particularly susceptible to mass wasting. Once eroded down Babeldaob's sloping terrain, the calm water of the extensive lagoon promotes coastal sedimentation.

Another environmental property with potential to impact human adaptive strategies is the limitations imposed by Babeldaob's coastline. The coastal perimeter is largely formed by a low coastal bench dropping directly into the lagoon and backed by moderately sloping land. At colonization, before changes in sea level, island subsidence and both natural and anthropogenic erosion altered coastal geomorphology, there would be limited sandy shoreline or level habitable areas. This imposes spatial restrictions on populations settling the coastal margins and adjacent terrain.

This contextual review also identified the extremely limited inclusion of earth structures in traditional narratives that restricts anthropological archaeological inquiry. Currently, the general conception by the local population is that Babeldaob's earthworks are natural features. This leaves understanding their timing, function and meaning entirely in the realm of archaeological investigations.

It has only been in the past decade that intensive studies of Palau's earthworks have been feasible. The majority of Babeldaob is thickly forested and rough terrain with the interior of the island largely uninhabited and the relatively small population living close to Babeldaob's coast. Until completion of the Compact Road in 2007, access to these coastal populated areas was largely by boat. This lack of modern development left many earthwork complexes undisturbed but also limited archaeological investigations of the inland landscape. As few jeep trails extended into the interior, only the more easily accessible areas were systematically archaeologically surveyed. Consequently a distorted picture of earthwork form, extent, distribution and patterning is represented in the archaeological literature.

The next section introduces Palau's earthworks by describing their morphology, distribution and size. It presents the first quantification of the extent of Babeldaob's modified

landscape and the relationship of terrace distribution to the environment. Also proposed is the first comprehensive classification scheme for Palau's earth structures.

4.0 ARCHITECTURAL FORM AND SPATIAL ORGANIZATION

The form, dimension and spatial organization of traditional architecture provide insights into the political economic strategies employed by cultural groups. This is particularly significant in examining the scale and complexity of monumental architecture as it is an indicator of a high-level of sociopolitical organization (Renfrew 1973; Trigger 1990). The premise being that construction of large structures demands control over resources and a large labour force, coordinated planning and advanced engineering skills. Of equal importance is the social information contained in the distributional patterning of structures and their relationship to the natural landscape.

The vast extent, diversity and complexity of Babeldaob's earthwork landscape has only recently been archaeologically recognized. The following chapter provides the first comprehensive morphological classification of Palau's earth structures, identifies the size of structures, complexes and clusters, and presents a spatial analysis of the extent of Babeldaob's modified terrain. Included in the analysis is an examination of the patterned distribution of earthworks in relationship to the natural environment and other terraces across Babeldaob's landscape. Information in this chapter is based on a long-term study of earthworks and incorporates standard pedestrian survey and remote sensing methods.

The form, size, extent and spatial distribution of earthworks on Babeldaob's current landscape are a culmination of centuries of occupation and sociopolitical development. Through time initially small structures may have grown into complexes and clusters of terraces may have expanded to incorporate larger areas then contracted as land was abandoned. Morphological forms changed in response to transformations in adaptive strategies. Structural size may have grown through accretion. A great deal more archaeological investigations are needed before temporal changes corresponding to form, size and distributive patterning can be identified.

4.1 Morphological Classification of Modified Terrain

Description of Palau's modified terrain began with the drawings of Hijikata (1993, 1995) and the initial categorization of earthwork types by Osborne (1966, 1979) and Lucking (1984). These first descriptive schemes grouped earth features into two main morphological categories: steep-sided and flat-topped hills called "crowns" and step-terraces; the two frequently though not universally found together. Lucking (1984:35–36) developed a step-terrace typology that identified three terrace types—brimmed, flat and backsloping. Also identified were the ditches circling crowns and cutting ridges. Additional component parts have recently been identified. Palau's earthwork landscape extends far beyond any relatively simple typology to encompass a wide range of morphological forms.

To adequately describe the diversity and elaboration of Palau's earthworks, a morphological classification system is devised based on the stylistic qualities of basic structural components that are then grouped into ideal type complexes. These ideal types do not represent every kind of Palauan complex; rather, they are the basis for a classification system that can be both augmented as additional distinguishing elements and types are recognized and is flexible enough to accommodate distinctions. This classification system is not meant to restrict the versatility or intricacy found in Palau's earth structures, to conflate their function and chronology or to reduce the earthwork complexes to bounded sites. It is intended to identify earthwork complexity, provide a common vocabulary for discussion and develop an organizational scheme useful for recognizing spatial, temporal and functional differences in structures.

Despite displaying considerable diversity in shape, orientation, size and location on the landscape, similar architectural components are found across Babeldaob with more comparative parallels than noticeable regional differences. Fine-tuning of the distribution of morphological types might disclose the dominance or restriction of particular forms to specific districts.

It is equally likely that morphological traits have temporal variation. As significantly more data is needed before chronological changes in design can be identified, this classification does not present a temporal order to the styles. Similarly, the construction sequence of individual structures is not taken into account in this chapter. Some forms may represent the final stage of a lengthy evolution while other forms may be frozen in a particular developmental stage.

4.1.1 Structural Components

Palauan earthworks are composed of nine principal and three less common structural components each of which is represented by varied forms and a wide range in size. The nine basic structural elements include step-terraces, basins, modified ridges, earth platforms, gullies, embankments or berms, levelled hilltops, crowns and ditches. Less common structural parts include causeways, saddle terraces and levelled areas. These components are not generally found as single structural elements but are both repetitive and conjoin with other elements to form earthwork complexes.

Step-Terrace

Step-terraces, or bench terraces, are the principal structural component of earthwork complexes (Figure 12 and Figure 13): These terraces are grouped in a series like a stairway and follow natural land contours. Three terms are used for step-terrace dimensions: height (of the riser), and width and depth of the terrace surface (the tread). Terrace risers can be low or high. Width is the distance from side to side (wide or narrow). Depth is the distance from front to back (deep or shallow). Low step-terraces are less than about a meter high while high step-terraces are generally over a meter high.

The two basic types of step-terraces are those that are wide and those that are deep. A third, less common type of step-terrace is the backsloping terrace. All three types of step-terraces can display a low or high riser. Wide step-terraces are those whose tread is wider than it is deep. Deep step-terraces are distinguished by treads that are deeper than they are wide. A backsloping terrace is a step-terrace whose tread slopes significantly down and away from its

riser and likely was bounded on its outer edge by a bund. Many of these backsloping terraces may be basins, unrecognizable due to erosional infilling (Liston 2008, 2011b).

The majority of Palau's step-terraces are grouped in a series like a stairway and follow natural land contours. Step-terraces can be cut from an existing slope or shaped by fill material. Access up and down some sets of step-terraces appears to have been gained by gently sloping ramps that extend the depth of the tier (Figure 12). The few identified ramps are in the tier's central quadrant of the tiers. Depending on their type and location, step-terraces served as agricultural features, as foundations for structures and as activity areas such as graveyards or lithic production areas. Some Earthwork Era villages are found on wide, low-stepped terraces while almost all Stonework Era villages are built on them.

Basin

A basin is an area lower than the surrounding terrain that is generally enclosed by a berm (Figure 14). Basins are found on the sides of earthwork complexes, in sets of step-terraces, at the base of gullies and on crowns (Liston 2008). Erosion, processes of decay and deliberate covering have infilled the features. This has led to their description as "depressions" in the archaeological literature.

Basins generally range in size from ca. 5 to 18 square meters with those next to wetlands possibly much larger. On crowns, basins encompass all or part of the summit and are sometimes divided into two by a berm. Their original constructed depth is not discernible without excavation. Centuries of erosion have lowered the surrounding berms so that they currently measure about a meter wide and less than 50 cm high. A single basin, on Oratelruul Ridge, exhibits berms constructed so high (≥ 2 m) they appear to form a walled enclosure (Figure 15). Although the berms lining other crown basins are now heavily eroded, none appear to have created high walls like that at Oratelruul. This very high walled enclosure on a crown probably served a different function than low-walled basins.

Basins are likely a variant of the wet-field terraces (Spencer and Hale 1961) found in Southeast Asia and appear to have been used as inland pondfields. The early cultivated wetlands, like those edging the mangrove forest at Ked era Aranguong (Figure 54), may have been carved to form basins and are the forerunners of Babeldaob's contemporary complex wetland field systems.

Modified Ridge

A modified ridge is a ridgetop that has been levelled and expanded by adding material or narrowed by cutting it away (Figure 16 and Figure 17). Ridgelines are common to Palau's topography so modified ridges come in a variety of sizes. In most cases, modified ridges form the foundation for other structural components such as step-terraces, earth platforms or gullies. Smaller ones connect earthwork complexes or forming trails. Larger ones are classified as an ideal complex type (Type I) and a major component of Type III complexes.

Earth Platform

Earth platforms are raised, four-sided and level-topped structures built by adding construction fill or cutting away the surrounding terrain (Figure 17). They are generally located spanning the width of a modified ridge or capping a levelled hilltop such as at Ngerbecharerong in Ngaraard (Liston and Rieth 2011). Some support a shallow step-terrace off their side. In most cases, they are not prominent features and their eroded edges can result in difficulty distinguishing them from the surrounding anthropogenically modified landscape. Stone pavements and alignments are frequently located on earth platforms. Some earth platforms cap and contain whole pots, small coral platforms, pottery caches and large stone-filled pits (Liston 2008, 2011b; Tuggle 2011). They likely served as foundations for structures.

Gully

A gully is a sloping channel that is wider than it is deep (Figure 18). Gullies are distinguished from ditches by their larger width. Gullies often lead from the top to the base of a complex where they empty into a basin or another gully sloping into a natural drainage.

Some gullies may be naturally occurring ravines that were artificially widened and cut to slope. Others were constructed by intentionally causing massive slope failures and hand digging. Sediments removed during gully modification or construction were used to build up adjacent earthwork components. Gullies are liberally dispersed throughout the earthwork clusters.

The gully's length is often lined with wide low step-terraces extending a portion or the entire width of the feature (Figure 19). A few gullies are faced in stone although their stonework may be currently covered by slopewash or was removed to create new stonework features (Liston 2008). Gullies served simultaneous drainage, irrigation, agricultural and defensive roles.

Embankment

Embankments are earth berms that are built-up or cut to shape. They generally line the earthwork component (e.g., basins, ditches) that produced their matrix or extend the width of a crown (Figure 20). When found on a crown, they generally cross the width of one edge of a rectangular feature. Very few embankments connect to outcrops or ravines to form enclosed spaces. Earth embankments are also found in Rock Island stonework village sites (e.g., Mariar).

Berms have widened and flattened over time due to the downslope transport of sediment with many eroded entirely back into their adjoining basins and ditches leaving no surface evidence. They were likely a more common structural component than currently identified. The existing dimensions of embankments, dramatically altered from their originally constructed form, are generally less than a meter high and 1.5 to 2.0 m wide. At the Obakelderaol (NA-2:19) complex's north base, a J-shaped embankment, approximately 0.9 m wide, 0.7 m high, and 24.0 m long, bounds the south and east sides of a level 20.0 by 30.0 m area (Liston and Rieth 2011:255).

Berms seem to serve to enclose a space or as a defensive feature. It may be that the substantially higher berms lining one side of some basins (e.g., Uluang, Figure 14) or the centre of a crown (e.g., Sisngebang) were a later addition to the larger feature and could have served a special purpose. The location and placement of some berms (e.g., in Airai) suggest they date to the Japanese administration and may have been World War II defensive features.

Levelled Hilltop

Levelled hilltops are hill tops or high points on ridgelines whose peak is cut flat (Figure 21). Levelled hilltops are found in earthwork complexes and as solitary structures. The latter are generally at higher elevations and often have a stone paving perched on their summit such as the one at Ngerbecharerong (NA-2d; Liston and Rieth 2011) and several encountered in the interior of Ngaremlengui.

They are distinguished from crowns by: 1) descending in what appears to be a largely natural hillside instead of cut steep-sided and high slopes and 2) larger summits. Most levelled hilltops are not associated with a ring-ditch although Ngerulmud with a surface area of approximately ca. 3800 m² is encircled by a ditch (Liston et al. 1998).

Levelled hilltops are not created to be as inaccessible as crowns but might be difficult to ascend due to natural topography. It may be that levelled hilltops are an earlier version of crowns or more likely they served a different function. They appear to have functioned as structural foundations and as activity areas. It is possible that levelling high points so that they could easily accommodate sentries or signal towers was Babeldaob's first earth construction projects.

Crown

Crowns, hills shaped into steep-sided and flat-topped forms, are Babeldaob's most distinctive earthworks. Crowns are often shaped into circles, ovals, rectangles and squares and display a generally small surface area (Figure 22, Figure 23, Figure 24, Figure 25). Conical

crowns are not part of the Palau's earthwork typology.⁴ The term "crown" originated with Osborne (1966:150–151), who described modified hilltops and its adjoining base terrace as "crown and brim" because of their combined hat-like appearance. "Crown" has since become the standard term to describe a flattened hilltop, with the feature often misrepresented by including any flattened raised earth feature.

Crowns were formed by elevating and sometimes extending the sides of a hilltop with fill material or by cutting and levelling the hill's surface. Crown faces were cut steep and high, making access to the top difficult and the summit relatively inaccessible. Although low crowns are found, higher features, rising as much as 10 m above the surrounding terrain, are more common. A few crowns are solitary structures but most are topographically integrated into an earthwork complex—not imposed or reworked on it—to form the high point overlooking the complex or entire area. Other crowns are lower in the shaped landscape to oversee a specific space. Even when lower, most crowns are very prominent on the topography and dominate other structures in their immediate vicinity.

There are at least 100 crowns on Babeldaob with more still hidden under the forest and not yet recorded. Perhaps a quarter of the known crowns are bounded by a ring-ditch (many of which are now infilled) while others are circled by a relatively narrow, ditchless terrace. At least a third of the crowns support basins that are now identifiable as shallow depressions. The tops of many crowns have no earth embellishments while some support earth knobs or embankments. These latter features may have been added late in the crown's use-life.

Possibly once supporting more stonework than is currently found on them, the relatively few stone surface features associated with crowns include pavements, large slabs, edgings, monoliths and facings. Basalt cobbles embedded in the sides of crowns suggest some of them may have once been entirely faced as both an engineering technique and as a symbolic decoration. The few crowns that have been archaeologically excavated with units large enough to examine contain buried basins, postholes, human burials and reconstructable vessels

⁴ It is probable that the "conical" crowns in Aimeliik (IM-6:1) and Ngatpang are actually eroded knobs.

(Kaschko 2007; Phear 2007; Tuggle 2007, 2011; Liston 2011b). Crowns at Sisngebang and Ngedelchong were excavated during this thesis work.

Circles or ovals appear to be the most common shape, followed closely by rectangles, often referred to as “breadloaf” crowns. Squares are less frequently occurring, and triangles are very rare. In part the base shapes may reflect the original hill topography formed and re-formed to accommodate changing site uses. A symbolic or functional significance corresponding to each particular shape has yet to be recognized. Despite temporal changes in their primary use, crowns served multiple simultaneous symbolic, defensive and ritual roles.

Ditch

Ditches are narrower than they are deep. They are found cutting across ridgelines where they are sometimes called ridge-cuts, extending down the length of step-terrace complexes, circling the base of a crown as ring-ditches, between adjacent crowns and occasionally splitting a crown (Figure 26 and Figure 27).

Ditch excavations reveal a rounded, and occasionally V-shaped, base. Earth dug during ditch construction sometimes formed an embankment to deepen the ditch. Some ditches operating as defensive features, specifically those cutting across ridges, did not have an embankment as it would have removed the element of surprise needed to capture the unsuspecting attackers. These embankments have eroded back into the ditch, obscuring its original depth with many infilled ditches now only recognizable as shallow dips in the landscape or by vegetation differences.

Ditches do not appear to have held standing water, like a moat. However, gleyed soils, evidence of standing water, may have been removed during periodic ditch maintenance. Ditches were both water control and defensive features, and in some instances accomplished both jobs simultaneously.

Saddle Terrace, Causeways, Levelled Areas

A saddle terrace is a levelled space bound on opposing sides by terrace risers and steep descents (Figure 28). Relatively rare features, saddle terraces are often prominent as they descend between two substantially higher earthworks. It appears that some may have been paved or held a stone paving. Levelled areas are artificially flattened spaces. Most levelled areas are already components of a structure, for example, step-terrace treads or levelled hilltops, ridges and crowns. However, there are slopes flattened by cutting or infilling that do not fit into other earthwork categories. Levelled plains can be solitary earthworks or found in complexes, such as between the ditches on the ridge ascending to the crown in Type IIIa complexes.

Causeways are relatively narrow, levelled and often long earth alignments. They are sometimes bounded by steep descents and other times eroded below the surrounding topography. Narrow earth causeways criss-cross Babeldaob as trails and provide access across some ditches. In the latter case, they may be a later addition to a long abandoned structure.

4.1.2 Ideal Type Complexes

Ideal type complexes are formed from various combinations of the twelve structural components. The four ideal types do not identify all the elaborate variations of earthwork complexes but distinguish the most prevalent groupings of component parts. Crowns are considered a component part of a larger earthwork complex rather than their own ideal type complex.

Type I

Type I earthwork complexes are lengthy ridgelines modified to serve as the foundation for additional earthwork components (Figure 16 and Figure 17). They differ from ridgelines leading to crowns (Type III) or those entirely fashioned into step-terraces (Type IV) in that the ridgeline is the focal point of the complex. An ideal Type I complex is a level, artificially flattened and either narrowed or widened ridgeline of substantial length that is capped by a

series of earth platforms extending the width of the ridge cusp. Gullies descend the ridge slope between the earth platforms, step-terraces are on the ridge slopes and in the gullies and a ditch may bisect the width of the ridge.

Due to innate ridge topography, Type I complexes overlook a vast extent of surrounding terrain, but they are not the highest point on the landscape. Stonework is commonly located on Type I complexes in the form of pavings and edgings. Dense scatters of traditional pottery sherds and lithics are associated with ridge complexes and whole pots and pottery caches have been unearthed in the classic Type I complex of Tabelmeduu in Ngaraard (Liston 2008; Tuggle 2011). At least one of the functions of Type I complexes appears to as ceremonial or ritual centres or elite residential areas.

Type II

Type II complexes are entire hills whose summit is levelled and whose sides and adjacent ridges are formed into alternating radiating gullies and step-terraced ridges (Figure 21 and Figure 29). These earthworks are domineering, extensive complexes such as the classic Type II complex of Ngermedangeb in Ngatpang. The levelled hilltop, sometimes fashioned into a low crown, overlooks the entire structure. Step-terraces cut into the hillslopes are generally deeper than they are wide and have both low and high risers. Narrow low step-terraces extend across the gullies that empty into broad expanses of level plains, some of which may have been constructed as basins but are now infilled with erosion.

Stone pavings and edgings are commonly found on Type II complexes. Pavings are not located on each tread but the original extent of stone features is unknown as it is probable much of the stone building material was removed to construct nearby villages of a later age. Only the outer edges of these massive complexes have been archaeologically investigated. It is likely that Type II complexes supported important Earthwork Era villages containing habitation, cultivation and activity areas within the core area.

Type III

Type III earthwork complexes are characterized by a distinct ascending ridge culminating in a crown whose shaped summit is the physical focus of the complex (Figure 30). The crown is found at either end or within the ridge. The height of the generally small diameter crown is magnified by deep ditches cut into its base. The sides of the ridge either fall steeply without any apparent modification to eventually connect with a series of step-terraces, or are shaped into wide high step-terraces.

Many Type III complexes are now heavily forested although at one time the crown's summit provided a clear 360-degree view and was prominently displayed to the adjacent earthworks. Stone pavings are often located on the crown whose slopes may have been entirely faced in stone. Now largely eroded, stone facing is occasionally found on some of the step-terrace risers and ditches. The step-terraces occasionally support a paving and stone edges the outer treads of some components. *Klidm* (stone faces) and Palau's only known petroglyphs are located on Type III complexes. It is possible Type III complexes were used as symbolic features, for ritual activities and in warfare.

Type III complexes are divided into two subtypes based on ridge morphology. In Type IIIa complexes, the ridge leading to the crown is cut into levelled plains separated by deep ditches. There is often a ring-ditch around the small high crown such as the classic and massive Type IIIa Ngulitel complex in Ngaraard. A Type IIIb complex is distinguished by high step-terraces leading to a slightly larger crown than found at Type IIIa (Figure 31). If ditches are present at all they are few and the crown is generally not contained in a ring-ditch. Roisingang in Ngaraard is the typical Type IIIb complex.

Type IV

Type IV earthworks are composed almost entirely of wide step-terraces accompanied by gullies and basins (Figure 32). If a crown is present, it is not dominating the complex but low and incorporated into the larger structure. Some of the step-terraces may contain basins and basins may be found at the base of gullies and ditches. Gullies containing low step-terraces

bisect adjacent sets of step-terraces. Ngeskebei in Ngaremlengui is the classic Type IV complex.

As stonework villages dating to a later period than the Earthwork Era are supported by Type IV earthworks, stone platforms, pavings, paths, wells and the like are commonly associated with the complexes. However, those Type IV earthworks that are not identified as stonework villages currently display very little stonework. It is likely these were largely used to support agroforestry and dryland field systems. The primary use of Type IV earthworks may have transformed over time from largely cultivation to habitation. Although there are likely subcategories of this ideal type, there is not enough known to make this distinction at this time.

4.2 Size of Structures and Complexes

The visually impressive earthwork complexes and structural components can be massive in their dimensions; far larger than they need be to accomplish any practical function (Figure 31).

Varying greatly in dimensions, earthwork size is somewhat dependent on the proportions of the underlying ridge or hill with extensions added to reshape or enlarge the feature. Structural size may have varied through time through either accretion or individual structures being constructed larger from the onset (see Chapter 6). Similarly, over time, many structures have widened, flattened or infilled due to the downslope transport of sediment via soil creep and slope wash processes. There can be little remaining surface evidence of ditches or berms with extensive excavation needed to identify their originally constructed size.

In general, step-terraces exhibit tiers ranging from about 2 to 20 m deep and wide with almost vertical risers from 0.5 m to 3.0 m high. Basins generally range in size from ca. 5 to 18 square meters. Berms have eroded to a height of about 0.5 to 1.0 m. Unusually high berms of close to 2 m line the four edges of one of the three crowns on Oratelruul ridge (Figure 15). In Aimeliik a 2 m high, 3 m wide and ca. 180 m long berm stretches between two ravines to enclose coral platforms (Osborne 1966:178–180; Masse et al. 1982:47).

Excavation identifies the constructed dimensions of ring-ditches—without the added height of an embankment—ranging from 4.5 to 6.0 m deep. They can be up to 7 m wide although their original width was likely substantially narrower with expansion due to natural degradation processes. While most ditches are only as long as the width of the ridge or length of the complex they bisect, a ditch dissecting level terrain in Ngiwal is unusual in that it is over 150 m long.

Low crowns of three to four meters high are found, but taller features, rising almost vertical as much as 10 m above the surrounding terrain, are more common. Crowns display a generally small surface area of ca. 80 to 300 m². The surface area of levelled hilltops is generally only slightly larger. Whether considered a crown or a levelled hilltop, the surface of Ngerulmud is at the high end of the range at ca. 3800 m² (Liston et al. 1998). The single measured knob on a crown, certainly eroded, currently measures 4.0 by 5.0 m and 2.5 m high (Tuggle 2011:218–227). Earthwork complexes are difficult to measure as they connect to other structures. The main structure can measure up to roughly 0.09 km².

4.3 Extent of Earthworks

Historically, Palau's terrace sites were archaeologically located by their visibility from afar. Osborne's (1966) initial earthwork survey was largely accomplished through inspection of aerial photographs. Most of the following field surveys identified terrace structures from boats, trucks or the tops of high hills without visiting the sites. Site boundaries were delineated by the forest edge, where the earthworks are no longer discernible. Furthermore, often both aerial and pedestrian survey efforts failed to recognize the more subtle structural manifestations of the earth features. Therefore, only those terraces that are clearly recognizable and in the 18 percent of Babeldaob that is covered in savannah were recorded.

From this perceived distribution of terrace structures grew the misconception that the vast majority of earthworks are in savannah, that an earthwork is a solitary bounded site and that structural components are largely limited to step-terraces, ditches and crowns. In addition to impeding accurate archaeological interpretations, this led to terrace construction and use being

faulted as the significant cultural variable behind the infertility of the associated treeless landscape.

4.3.1 Spatial Analysis Methods

Babeldaob's earthworks were located through an archaeological literature review, aerial photographs and pedestrian survey. Identified sites were quantified and compared with the natural landscape in a GIS environment (ESRI ArcGIS 9.2 and 10).

Despite the high resolution of Palau's current satellite imagery (i.e., 2005 QuickBird satellite imagery, Google Earth, 2003 IKONOS [GeoEye Corp.]), light-and-shadow contrast makes aerial photographs significantly superior for identifying earthworks in the savannah (e.g., Figure 4). Hence, only aerial photographs were used in the analysis. The difficulty in identifying earthworks in any aerial photos is the density of the upland forest covering over 60 percent of Babeldaob's volcanic terrain. Earthworks in these areas can only be identified through pedestrian survey over rough topography with limited vehicular access. Wide-band synthetic-aperture radar (SARS), more appropriate for the thick vegetation than LiDAR, that is capable of revealing sub-meter resolution of the topography beneath the forest canopy is not available for Babeldaob.

A selection of over 2,000 black and white and colour U.S. government orthophotos flown in 1946, 1947, 1968, 1971, 1976, 1992 and 1994 and ranging in scale from 1:3000 to 1:20000 were collected from Henry Wolter, USGS Geospatial Liaison for the Pacific Islands, the Palau Bureau of Land and Survey, the Bernice P. Bishop Museum in Honolulu and Dr. Pat Colin at the Coral Reef Research Institute in Palau. More recent aerial photographs taken by Dr. Colin were also added to the collection.

Those orthophotos that were not in digital format were scanned at a high-resolution. About 100 of the photos with the sharpest image were georectified in ArcMap. Archaeological pedestrian survey was conducted to field check sites identified in the orthophotos and to survey previously uninvestigated terrain. Polygons were created on GIS base data layer of

earthworks identified in the aerial photos, in previous archaeological reports and in pedestrian surveys of portions of Ngaremlengui and to a lesser extent Aimeliik, Ngaraard, Ngarchelong and Airai. The GIS base layer contains earthworks identified through April 2011. Matt Bell produced the final GIS based figures under the direction of Liston.

4.3.2 Extent of Modification

Figure 33 is an ArcMap generated image showing the distribution of Babeldaob's identified earthworks and the extent of archaeologically unsurveyed terrain. About 63 percent of Babeldaob's volcanic landscape has yet to be archaeological surveyed.

Earthworks are confirmed on 45.9 km² or 14.6 percent of Babeldaob's volcanic landscape. Forested sections of the island yet to undergo pedestrian survey constitute about 63 percent (180 km²) of the island's volcanic soils. Based on the amount of Babeldaob's unsurveyed forested land, the high percentage of identified terraces with forest regrowth and the probable location of additional earthworks, it is estimated that a minimum of 18 km² of Babeldaob's forested sculpted terrain has yet to be identified. When combining this estimate with documented terraces, it is probable that 64 km² (20.4 percent) of Babeldaob was shaped into earth structures in the past.

There are undoubtedly barren or savannah covered earthworks that have eroded to the extent that they are almost completely unrecognizable as earthwork structures (e.g., south-central Ngaraard, southwest Ngaremlengui). It is also likely that many of the Japanese administration's 1.1 km² of bauxite strip-mines destroyed ancient earth structures on hilltops inside the Ngardmau earthwork district.

4.3.3 Relationship to Natural Landscape

The relationship of earthwork sites to elevation, slope, current vegetation cover, soil map units and geological formations was analysed using the earthwork data layer. Without a high mountain range, Babeldaob has no rain shadow or a significant variation in temperature and

precipitation. Behavioural strategies related to the environment that were chosen by the Earthwork Era population should be in relation to these general natural variables.

Earthworks are found between 5 and 200 m amsl, at all but Babeldaob's maximum elevation of between 200.0 and 213.5 m amsl (Table 10). While 6.7 km² (14.6%) of the terraces are located between 5–10 m amsl only 0.1 km² (0.3%) are located at 175–200 m amsl. The majority of earthworks (32.9 km², 71.8%) are found between 10 to 75 m amsl with most of those found between 25 and 50 m amsl (14.9 km², 32.5%). Due to the bulk of forested unsurveyed land being in the more mountainous interior, it is likely the amount of earthworks in the higher intervals will increase as additional terraces are documented.

Earthworks are most commonly found on steep terrain with 20–50 percent slope (18.9 km², 41.1%) (Table 11). There is a significant drop in the extent of earthworks constructed in the next category with only 8.4 km² (18.2%) found on very steeply sloping land (50–75%). The remaining categories are rather evenly distributed with gently sloping (2–6%) terrain containing 5.6 km² (12.4%) of terraces, strongly sloping (6–12%) land displaying 5.9 km² (13.0%) and moderately steep (12–20%) terrain having 7.0 km² (15.2%) of the earthworks.

Geology

Earthworks are found on each of Babeldaob's three volcanic basements (Table 12). Of the 42.31 km² of earthworks that correspond to the GIS geological formation data layer, 0.77 km² (1.8%) are within the Babelthuap Formation (Tb), 16.86 km² (39.8%) are in the Ngeremlengui Formation (Tn) and the remaining 24.68 km² (58.3%) are in the Aimeliik Formation. Within the Aimeliik Formation, earthworks are shaped into 7.79 km² (18.4%) of the Ngardok Member (Tat) and 16.89 km² (39.9%) are in the Ngarsul Member (Tan).

Although the low percentage of shaped terrain in the Babelthuap unit suggests this volcanic basement is unsuitable for earthworks, this is likely due to its upland unsurveyed interior location. The Babelthuap Formation is both furthest from the shoreline and the least

archaeologically surveyed of all the units. Once additional pedestrian survey is conducted in the uplands it is likely that more of the Babelthuap Formation will be represented.

Vegetation

Following Cole et al. (1987) land cover is classified as forest, savannah, agricultural and other. The “other” category includes urban land, barren terrain and undocumented land cover. Of the 45.8 km² of documented earthworks that correspond with vegetation categories, approximately 24.7 km² (53.8%) are currently forested with 15.9 km² (34.8%) covered in savannah vegetation (

Table 13). An additional 4.5 km² (9.9%) of terraced terrain is classified as agricultural land and 0.7 km² (1.6%) of earthworks are within the inclusive category of other. In most cases, those terraces that are in savannah are covered in grasses. However, a significant although unquantifiable number are covered in ferns and other plant species able to grow in infertile soil with high soluble aluminium content.

An estimated 18 km² of terraced terrain is undocumented due to being covered in forest and not visible in aerial photos. Adding this figure to the recorded forest covered structures considerably changes the distribution of terraces in the vegetation categories. Of the estimated 64 km² of Babeldaob shaped into earthworks, about 66.7 percent (42.7 km²) is forested, 24.9 percent is in grassland, 7.1 percent is covered in cropland and 1.1 percent is in the “other” category. Regardless of whether the substantiated or the estimated earthwork figures are used in the analysis, the majority of earthworks are covered in forest vegetation. Unquestionably 54 percent (24.7 km²) and probably 67 percent (42.7 km²) of Babeldaob’s earthworks are under forest cover.

Soil

With volcanic soils covering about 80 percent of Babeldaob not surprisingly, 97.1 percent of the island’s terraces are in the volcanic uplands (Table 14). The remaining 2.9 percent are found on marine terraces in the Tabecheding-Ngatpang-Dystrudepts soil map unit. Of the

earthworks in volcanic soils, 89 percent (40.8 km²) are in the Aimeliik-Palau map unit and about four percent (ca. 2 km²) are in each of the Ollei-Nekken and Babelthaub-Ngardmau-Udorthents units.

The large cluster of earthworks in Ngardmau is on Babeldaob's bauxite soils. This suggests that the population could accommodate these highly infertile soils. Certain soil units, such as Airai clays, were probably avoided due to their poor construction properties. However, both Airai clays and bauxite compose a very small proportion of the entire island's soils.

The Palau soil series, characterized by savannah vegetation, is often incorrectly equated with earthworks. The Aimeliik soil series, predicted by forest cover, is actually where most earthworks are found. As the majority of Babeldaob is forest covered, it is not unexpected that most terraces are in the Aimeliik series. Hence, there is not a direct correlation between terraces and either the Palau or the Aimeliik soil series. However, earthworks soils are directly associated with Aimeliik-Palau soils. This is largely foreseeable since this soil unit composes over 80 percent of the four soil units in the volcanic uplands category.

Discussion

Taking into account Babeldaob's natural landscape, with the available data the correlation between earthworks and environmental variables is related to rivers, coastlines and to an extent perhaps elevation and slope. As the vast majority of Babeldaob is defined by volcanic soils and upland forest, this is where almost all earthworks are located. Terraces are rather evenly distributed along Babeldaob's three volcanic basements if the projected amount of yet unidentified earthworks is taken into account.

Low-lying terrain adjacent to rivers, coastlines and river mouths is more fertile due to sedimentation and the slopes above these areas are shaped into structures. Rivers also provide access between the interior and the coastline.

There is a significant quantity of earthworks located on steep terrain with 20–50 percent slope and at 10 to 75 m amsl. These figures may change with the addition of the yet undocumented forested terraces. It is unlikely the proportions between the categories will vary.

4.4 Patterned Distribution

Earthworks complexes are generally not single, isolated structures but congregate and adjoin one another to form clusters of modified terrain. These clusters are interpreted to be architectural expressions of social organization where clusters represent sociopolitical districts defined by earthworks.

As shown in Figure 34, Babeldaob's modified terrain congregates into ten clusters that are roughly confined to the approximate configurations of Babeldaob's ten modern political states. Although some of the landscape inside the clusters may not be terraced, earthworks are not identified inside the entirety of the Figure 34 clusters as none of them have been thoroughly surveyed. Additionally some terrain is so heavily eroded that it is difficult to determine if it was once shaped. Each cluster of earthworks is separated by wide spans of largely unterraced land containing considerably smaller groups of more modest earth features. Some of the terraces outside of the large clusters may be part of the cluster but the land between the two is not yet surveyed.

The clusters on the current landscape vary in size from roughly 8 to 27 square kilometres with Aimeliik and Ngaremlengui appearing to be the largest clusters. Substantial archaeological survey is needed to accurately identify the extent and borders of earthwork districts.

Distribution between Earthwork Clusters

A large proportion of each cluster's boundary is defined by the shoreline. The cluster's inland boundaries are not yet precisely identified. It appears that the clusters in central Babeldaob extend from the coast to the central ridgeline, the Rael Kedam, to encompass the coastal, lowland and highland resource zones (see Liston 2007a). The clusters along the

island's neck are located from shoreline to opposing shoreline. Predicting the inland boundary of the Aimeliik and Ngardmau clusters is problematic, as they do not have a clear naturally formed inland border.

Except for along the neck of the island, the spatial distribution of earthwork clusters primarily correlates with the larger water catchments and estuaries and access to the deep-water passages through the reef out to the open ocean. This patterning appears to be due to biogeographical factors related to accessibility to key resources. The larger rivers provide fresh water and ease of access between the interior, the riverbanks, the lagoon, reef and the sea to offer a wide range of marine and terrestrial resource zones. Before siltation and expansion of the mangrove forest, many of Babeldaob's waterways were large enough to accommodate traditional vessels that could travel deep inside the earthwork clusters.

Apart from the association of rivers and coasts with wetlands, soil type does not seem to factor into the location of large terrace clusters. Not only are Babeldaob's soils predominately (>80%) infertile oxisols but much of the bottomland soils result from anthropogenic erosion generated by deforestation and earthwork construction and use. Before expansion into the interior for swidden cultivation and building earthworks, the extent of wetlands was likely very limited. Consequently the tripartite spatial correlation between rivers and coastlines, earthwork clusters and bottomland soils likely became firmly established only after long-term occupation of the inland areas.

It is significant that the zones of unmodified terrain separating the large clusters are generally outside the major watersheds but still close to perennial streams. Although the acidic soils in these generally archaeology barren zones is the same as that in earthwork districts, access between the coast, the lowlands and the interior is more difficult due to lack of inland waterways. Segments of these archaeologically barren zones may have once held earth structures or been used in swidden cultivation. The heavily eroded landscape, such as the expanse of badlands in Melekeok, has eliminated evidence of past human activities.

Although not archaeologically visible, the extent of the control over resources of these earthwork districts may have extended out to the adjacent productive lagoon and reefs as they do in traditional society (Johannes 1981). Not only were food and other resources in these mangrove and littoral zones important to a thriving economy but the open lagoon provided an additional protective barrier from attack.

Distribution within Earthwork Clusters

Within the clusters, earthwork structures form a spatially contiguous landscape of modified terrain. Those individual complexes that do not conjoin with other complexes terminate at natural features such as a stream, bedrock outcrop or wetlands. It appears that earthworks were not constructed at the source of rivers and large streams, probably due to the potential of anthropogenic erosion and siltation affecting the entire waterway.

The prevailing impetus behind the locational placement of individual earthworks seems to be the interrelated variables of intended function superimposed onto the potentials and limitations of topography and soil structure. It is unlikely that locations were chosen specifically for the underlying soil fertility as over 80 percent of Babeldaob is oxisols, soils that lose their fertility soon after being stripped of their forest cover.

In large part determined by natural topography, the patterning of morphological types inside an earthwork cluster is still being identified. The current distribution of earthwork types reflects changes over time in settlement pattern, subsistence practices and social organization, and may not accurately the patterning present at specific points in time. It appears that although some structural types functioned to support particular activities, many complexes were multifunctional and changed functions through time. Hence, morphological and functional patterning within a cluster may have temporarily fluctuated to some extent.

Type I complexes, long modified ridgelines, are generally positioned inside an earthwork district overlooking a vast extent of earthworks or coastline. Barricaded by thick mangrove forest, the few known Type II complexes are fronted by the lagoon or a large river. Located on

the outer edge but within an earthwork district, additional earthworks bound the remaining sides of the Type II complex.

Type III complexes, often dominating the surrounding landscape, are found both at the inland borders and in the middle of earthwork districts. In the latter case, they are surrounded by complexes of lower elevations. The crown on the Type III summit generally provides a clear 360-degree view that is prominently displayed to the adjacent earthworks and that can be seen by distant earthworks.

Although step-terraces are found on almost all sloping terrain in all types of clusters, the extensive Type IV complexes, defined predominately by step-terraces, generally front rivers, line stream drainages, and are cut into the slope just back from the shoreline. Low crowns perch on or close to some step-terrace systems. The thick mangrove forest lining these waterways was probably not as extensive when the earthworks were constructed. Other earthwork types or natural barriers surround Type IV complexes.

4.5 Summary: A Monumental Landscape

Vast areas of Babeldaob were transformed into monumental earthwork structures. With about 63 percent of Babeldaob's volcanic landscape yet to undergo archaeological survey, it is estimated that a minimum of 64 km² (20.4%) of the island was shaped into earth structures. Earthwork complexes are distributed into ten large clusters of contiguous modified terrain ranging from about 8 to 27 square kilometres. Individual complexes inside the larger clusters can be up to about roughly 0.09 km². They are shaped from the hills and ridgelines to dominate the surrounding terrain. With crowns measuring up to 10 m high and step-terraces with risers of over a meter, the structural components of these massive complexes are far larger than needed to perform any practical function. Monumentality in Babeldaob's earthwork landscape is thus created in both the size of individual structures and the extent of the contiguous earthwork landscape.

Although there are a few unusual earth structures, the varied architectural forms across the island are fairly homogeneous. The recognizable differences in morphology are in part due to underlying topography. This homogeneity could be a result of the function and meanings associated with each structural form. Over the years of trial and error, these architectural designs were found to provide the needed combination of practical function, construction stability, sustainable land use and water management. In addition, embedded in these forms are the ideological messages recognized and understood by the population. These similar forms identify island wide unity and interaction. The variations in embellishments and structural size may in part relate to the assertion of individual or community identity and status to other districts (e.g., Vega-Centeno 2010).

It is possible that the structural size and extent of Babeldaob's earth structures developed through long-term accretion of smaller structures rather than a single enormous construction effort. Agrarian landscapes of step-terraces, mounds, ditches and raised beds often grow by accretion (Doolittle 1984; Lansing 1991; Erickson 2006). With continued renovations the earthworks could have slowly grown in size so that their ultimate scale, and corresponding use as a symbolic leadership strategy, did not manifest itself until later in the cultural sequence. These issues are discussed in detail in Chapter 6.

The following chapter presents the results of the archaeological field investigations that contributed to understanding earthwork function, age and construction sequences. The excavations provided substantial data to aid in interpreting the development of sociopolitical complexity during Palau's Earthwork Era.

5.0 FIELD AND LABORATORY INVESTIGATIONS

Archaeological field investigations included an intensive pedestrian survey and data recovery excavation. Laboratory analysis consisted of the taxonomic identification of carbonized plant material, radiocarbon dating, chemical and physical soil analysis, examination for archaeobotanical remains and the collection of attributes from reconstructable traditional vessels. Table 15 summarizes the field and laboratory work conducted during the course of thesis work.

Most of the fieldwork occurred in Ngaremlengui and Melekeok (Figure 1) during 15 weeks between November 2008 and June 2010 under the direction of Liston with the assistance of a Palauan field crew being trained in archaeological techniques. Oral history was collected by Vince Blaiyok, a retired Palauan archaeologist.

Data most relevant to the research questions was produced in excavations on the Ngedelchong and Sisngembang crowns, close to the Roismelech crown and in the swale at Keder Aranguong (Figure 36, Figure 37). The results of these excavations are presented in detail while the remaining data generated by the investigations are briefly summarized and presented throughout the thesis where appropriate. Detailed site and excavation descriptions, labwork and interpretations will be in a field report on file at the Palau Bureau of Arts and Culture and the Ngaremlengui State Office.

Summary of Investigations

Pedestrian survey focused on the terrain north of Ngeremeduu Bay and on either side of the Ngermeskang River. Thirty-one sites were identified including fourteen earthwork complexes, eleven villages, three sites identified solely by stone structures, a series of earth trails, a potential quarry and the Yamato Japanese Era plantation. The eleven village sites include six stonework villages, four early stonework villages and a ridgeline village. Documented earthwork features range from various sized crowns, some with encircling ditches, gullies, step-terraces, causeways, ridgelines and earth platforms. Recorded stonework

features include pavings, platforms, paths, retaining walls, *euatels* (forts), wells and monoliths. Japanese Era defensive and farming features are present in many sites.

Archaeological excavation was conducted in seven earthwork sites in the states of Melekeok and Ngaremlengui. In the Ngaremlengui earthwork district, work occurred in the Ngedelchong and Sisngembang crown complexes, the Nkebeduul and Ongelwatel ridgeline sites, and the Ngeskebei and Ked era Aranguong step-terrace complexes (Figure 36, Figure 39). Also investigated was Melekeok's Roismelech crown complex (Figure 37). Field investigations included hand excavation of 49 stratigraphic trenches and profiling a wall facing.

Laboratory analysis consisted of the taxonomic identification of 48 samples of carbonized plant material, 34 of which were selected for radiocarbon dating with Accelerated Mass Spectrometry (AMS). Fifteen soil samples underwent chemical and physical analysis, ten soil samples were scanned for archaeobotanical remains and the attributes of seven reconstructable traditional vessels were analysed.

5.1 Background to Archaeological Fieldwork

The primary research area was in Ngaremlengui that contains one of the most extensive earthwork districts in Babeldaob. With a land area of ca. 65 km² and about 1.7 km² of mangrove forest, Ngaremlengui is Babeldaob's largest state (Figure 35). It is located in the centre of the island's west coast and extends from the shore east to the Rael Kedam ridge system. The largest estuary in Micronesia, Ngeremeduu Bay, defines the state's southwest border while its southern extent is roughly defined by the Nkebeduul River with Ngatpang on the opposing riverbank.⁵ Ngaremlengui's fiercely disputed northern border with Ngardmau is around Ngerchelechuus, Babeldaob's highest peak.

⁵ Boundaries between local jurisdictions, as well as between states, are subject to dispute and can change. None of the boundaries in this thesis are presented as the actual and legal boundaries of villages, village areas or states and should be considered approximations.

Thick bands of mangrove swamp fringe Ngaremlengui's coastline and river banks. The close to 16 km long Ngermeskang River, the longest river in Micronesia, drains into the north side of Ngeremeduu Bay and extends deep into the state's interior to support multiple branching streams and form the ca. 80 km² watershed. Other important waterways are the Chometubet stream and the Ngerdong River that branches into Taoch era Imeong and Taoch era Ngerutecher. Before the extensive mangrove growth, the latter river formed a deep inlet terminating beneath the set of partly exposed basalt mountains of Tmerou, Sechedui and Ngeruach and Etiruir. Collectively called Rois Mlengui, the prominent range is geographically and culturally important to the Palauan population.

The Toachel Mlengui, the primary channel through the western fringing reef to the open ocean, fronts the peninsula formed by Ngeremeduu Bay and the Taoch era Imeong. The majority of the interior of the state is rugged terrain covered in thick secondary forest. The state's west quadrant is largely savannah-covered hills, interspersed with steep valleys and forest.

Ngaremlengui under the name of Imeong, the capital village, is one of the demigod Milad's four children and is the area where she first introduced pondfield cultivation of *kukau* (*Colocasia*). In traditional history, Ngaremlengui contained approximately 40 villages and was called Kerngilianged or 'dwelling as if in heaven' (Parmentier 1981:321).

After carefully analysing Babeldaob's soil fertility, the Japanese administration placed three large agricultural plantations within the Ngermeskang watershed. The Yamato (ca. 365 ha) and Nantak plantations on the Nkebeduul River and the Asahi Mura (ca. 486 ha) on the main branch of the Ngermeskang River (Iida 2012). In ancient times, these productive soils likely contributed to the placement of extensive earthworks and stonework villages along the riverbanks. The Japanese removed many of Ngaremlengui's anthropomorphic stone images (*klidm*) in an effort to suppress the "old" religion (Lucking 1981:44).

Ngaremlengui is divided into eight archaeological traditional village areas: Ngchemesed, Ngermetengel, Imeong, Ngermeskang, Ngerdesiur, Ngerchelechuus and Ngerbechedrengul.

All but a few of the current population of about 350 live in Imeong and the coastal settlement of Ngermetengel.

5.1.1 Previous Archaeological Investigations

Krämer (1919) mapped several of Ngaremlengui's old settlements in the early 1900s. In the late 1920s Hijikata (1993, 1995), unable to find an adequate Palauan guide, conducted extremely limited investigations in the state.⁶ Inventory survey was conducted in parts of Ngaremlengui by Osborne (1966), Gumerman et al. (1981), Blaiyok et al. (1986), Snyder and Butler (1989) and Olsudong et al. (1998). Lucking's (1984) thesis on Palauan terraces included a brief discussion of several terraces and excavation and mapping of the Uluang crown complex.

More recently, U.S. federal and Palauan laws have instigated cultural resource management work resulting in archaeological investigations associated with the Ngaremlengui State Quarry (April and Pantaleo 2002; Pantaleo 2002), the Compact Road (Wickler et al. 2005; Liston et al. 2007; Liston 2011b; Tuggle et al. 2011) and the PNCC Telecommunication Project (Liston et al. 1998; Cochrane et al. 2005). Ngaremlengui's other anthropological studies include retrieval of two wetland paleocores (Athens and Ward-2005), documentation of several monoliths (Van Tilburg 1991), collection of ethnographic data (Parmentier 1984, 1987; Holyoak et al. 1998) and a study of recent traditional resource utilization and management practices (Klee 1972). None of the three radiometric dates produced by these archaeological investigations are considered legitimate (Liston 2005).

5.2 Field and Laboratory Methods

The objectives of the archaeological investigations were to both collect data for thesis research and to train Palauans from Ngaremlengui state in Palau's archaeological history and in scientific field methods. Pedestrian survey was conducted with three to five archaeologists

⁶ According to Hijikata (1995:26–27) the Palauans thought that he might be a spy sent to investigate their religion by the Japanese government. The Japanese administration severely restricted local ceremonial customs and beliefs claiming that it was superstitions.

following the most straightforward path to those hills and ridges identified on aerial photos and maps as potential earthwork sites. Cultural properties encountered during the survey were plotted on a topographic map, described on field forms and photographed in digital format. In some cases, schematic plan view maps were drawn indicating earth and stone features and artefact concentrations. Larger stone structural features were mapped with a tape and compass. To ensure the exposure of the full extent of individual features, extensive vegetation clearing preceded the mapping. Occasionally surface artefacts were collected. As traditional pottery scatters are ubiquitous throughout Palau, sherds were collected only if the scatter contained a diagnostic lithic tool, a complete pottery vessel or a large proportion of diagnostic sherds.

Data recovery methods were those found to be most suited for collecting meaningful data from earthwork features. Small-scale controlled test units (e.g., 1 m² units) are not appropriate in these monumental features as accurate interpretation of the complex stratigraphy and the likelihood of encountering subsurface features relies on the exposure of long soil profiles. The most expedient methods of producing high quality data on earthwork complexes are surface stripping, stratigraphic trenching and the facing of Japanese defensive features. Trench sidewalls provide a wealth of data for understanding site formation processes and collection of artefacts or charcoal samples. All excavations were conducted by hand with a shovel and trowel. Backhoe trenching results in the destruction of the site's integrity and should only be used when the property is slated for imminent destruction or extensive alteration.

Shovel tests were dug to aid in locating potential cultural deposits and subsurface features, to determine feature and specific matrix boundaries and to assist in decisions regarding stratigraphic trench placement. Shovel tests were not used to provide interpretational data and soil or charcoal samples were not collected from them. Shovel tests were a minimum of 40 cm in diameter.

Forty-nine stratigraphic trenches were excavated and one backhoe wall was faced (Table 15). Excavation terminated on bedrock or a minimum of 10 cm beneath what was interpreted to be the intact C horizon. As intact saprolite is often misidentified in earthwork sites due to its

resemblance to construction fill, a shovel test was dug into the base of the finished trenches to ensure that the basal layer was indeed reached.

Stratigraphic analysis was directed toward identifying intact subsurface deposits and specialized subfeatures related to periods of pre-Contact occupation and documenting site formation processes. Interpretation of stratigraphic exposures and the collection of samples with relevance for meaningful radiocarbon age determination and soil floristics were the primary means of data collection from the excavations. All charred wood remains were collected from trench sidewalls as point-provenienced samples. This method ensures secure provenience data and in the majority of cases allows for the collection of one taxon per charcoal sample.

Stratigraphic profiles were drawn and photographs taken of at least one face of all excavation units. Soil descriptions conform to U.S. Soil Conservation Service and Munsell colour notation standards. Babeldaob's volcanic soils are composed of three basic stratigraphic units. The A horizon is a ca. ≤ 8 cm thick fragile topsoil composed of silty clay loams mixed with decomposing plant matter. The underlying B horizon is a generally very deep stratum of fine textured silty clays. These very dense, reddish-orange soils are formed in saprolite (the C horizon) derived from volcanic rock. The heavily mottled and veined saprolite displays variations of purples, yellows, reds, and oranges in an orange, yellow, or white base. This terminology is used in the interpretations of the depositional units presented in this chapter with corresponding profile drawings located in Appendix B.

A detailed record of all excavations was maintained, including field notes, photographs and a field specimen catalogue.

5.2.1 Laboratory Methods

Traditional pottery sherds, micro-crystalline quartz (crypto-crystalline silicate [CCS]) flakes and debitage, charcoal and occasionally basalt tools compose the majority of artefacts and midden encountered in terrace excavations. Due to the acidic soils, flora and fauna

remains, human skeletal material and shell implements or jewellery are rarely encountered in Babeldaob's earthwork deposits.

Whole pottery vessels, some diagnostic sherds and lithics and charcoal and soil samples were collected during archaeological fieldwork. Artefacts collected were cleaned, identified and sorted to class. Collected material remained on Palau unless specialized analytical equipment was required. Details of laboratory analyses are provided in this and the following chapters. All material collected during the investigations, including fieldnotes, maps, charcoal samples, traditional pottery and lithics, is curated at the Palau Bureau of Arts and Culture. Soil samples were disposed of due to the lack of storage facilities for such a large number of bulky samples and their certain deterioration in a non-refrigerated and humid environment.

The goal of traditional pottery collection was to document the intentional placement of whole vessels. To this end, the large quantity of non-diagnostic sherds unearthed in the excavations was left in place. Only reconstructable vessels and those diagnostic pieces in a datable context were collected. Seven reconstructable were recovered. The vessels were analysed with the collection of metric and descriptive attributes (Table 16).

Charcoal samples were collected as point-provenienced samples directly from subsurface features or cultural layers on stratigraphic profiles with a clean trowel and stored in aluminium foil. Samples were not extracted from bulk soil collections or from the screen. This method ensures secure provenience data and often allows for the collection of one taxon per charcoal sample.

Forty-eight carbonized samples underwent wood identification by Gail M. Murakami at the International Archaeological Research Institute, Inc. Wood Identification Laboratory prior to being submitted for radiocarbon dating. The primary objective of wood identification is to determine sample fitness for radiometric dating by reducing the error caused by long-lived taxa, eliminating historical introductions or foreign driftwood and ensuring fossil fuels are removed from the sample. Of the submitted samples, it was not possible to identify 20 even to family; hence 29 wood samples were identified. Table 17 lists the newly identified charcoal

taxa with their common English and Palauan name, whether the plant is native or introduced, its habitat and known traditional uses.

After undergoing wood identification, 37 samples of charred plant remains were selected for dating at the University of Waikato Radiocarbon Dating Laboratory. All samples were pre-treated with acid/alkali/acid and most were analysed by accelerated mass spectrometry (AMS) with the few of sufficient size (over 2 g) dated by conventional methods. As three of the samples were too small for analysis, only 34 samples were radiometrically dated. Samples were calibrated using OxCal v. 3.10 software (Bronk Ramsey 2005, atmospheric data from Reimer et al. 2004) at two standard deviations (95.4% probability) using the Intcal04 calibration curve (Table 18). A thorough discussion of radiometric dating issues in Palau's archaeological context is presented in Chapter 7.1 and 7.2 (see Liston 2005).

Soil, pollen and phytolith characterization studies were conducted to explore Earthwork Era cultivation practices. Bulk soil samples were collected from depositional units in faced trench profiles with a trowel cleaned in distilled water. Samples were taken across a narrow vertical range of 4–5 cm after the previously exposed surface was removed to ensure an uncontaminated collection. Sediments were placed in plastic bags and stored in a refrigerator until shipped for analysis.

The objective of the soil characterization studies was to identify differences in Palau's cultural soils and the relevance of soil characteristics to cultivation practices. Chemical soil analysis of 15 bulk soil samples was conducted by Clancy Iyekar under the direction of Dr. Mohammad Golabi of the Western Pacific Tropical Research Center at the University of Guam (Table 19). Soil samples were analysed for pH, organic matter content, percent of total carbon, percent of total nitrogen and nutrient content. Soil texture analysis was also performed. The soil's physical characteristics are documented in Table 20. As shown in Table 20, the samples all documented strongly acidic soils and identified no variation related to potential human use or the addition of soil supplements (Golabi, pers. communication, 2010).

Pollen and phytolith characterization studies of Babeldaob's terraced soils generally produce minimal results. The purpose of the study was to attempt to identify cultivars in cultivation features in the earthwork landscape. Ten bulk soil samples from the identical contexts that underwent soil analysis were submitted to PalaeoWorks Consulting at the Australian National University for pollen and phytolith characterization studies. Dr. Simon Haberle conducted the analysis by scanning each sample for micro and macrobotanical remains to assess the potential contribution of more in depth analysis. The pollen and phytolith content in 10 of the submitted sample was non-existent, one sample was dropped from the analysis and three samples are awaiting more detailed analyses (Table 21).

5.3 Sisngebang Crown Complex

Sixteen stratigraphic trenches were excavated at Sisngebang (Site NM-1:7). Sisngebang is a prominent basalt outcrop north of the narrow entrance from the lagoon into Ngeremeduu Bay (Figure 38). The outcrop and the terrain immediately below form an elevated crown earthwork complex collectively referred to as Sisngebang. Perched at 126 m amsl, at the terminus of a terraced, south-westerly trending ridge, it is the highest point in Ngaremlengui's southwest corner.

Sisngebang is within the Ngchemesed village area and is surrounded by an earthwork landscape (Figure 39). To the north the highly eroded earthworks are almost undetectable while those in the savannah extending east to the Ngermeskang River retain their fundamental integrity, and those in the fragmented forest northeast to Rois Mlengui and west to the lagoon are relatively intact. The thin strip of land between Sisngebang and the bay is moulded into terraces where bedrock is not exposed.

The summit of the outcrop affords a view west across the lagoon to Toachel Mlengui and southwest over Ngeremeduu Bay to the Ngermedangeb earthwork complex (Figure 21) at the west edge of the Ngatpang earthwork district. To the east, the line of sight extends across central Babeldaob to the central ridge, the Rael Kedam, and to the northeast to the high Rois

Mlengui mountains. Sisngebang possesses the most commanding uninterrupted view in western Babeldaob and dominates the surrounding landscape.

Sisngebang soils are classified as the Ollei-Nekken map unit—shallow or moderately deep, well drained soils with lower fertility. They currently support grasses maintained by fires set every three to five years. Upland forest is encroaching onto the earthworks except on the south where the steep, thin-soiled, occasionally terraced slope, descends to the *taoch* bordering the south base of the ridge. Only where the soil was stripped during earthwork construction to both level the terrain and supply fill material is a gravelly, loose bedrock or intact saprolite encountered close to the surface; otherwise, the stratigraphy is largely composed of ancient habitation and construction matrices overlying a mottled basal saprolite.

To the west the broad, terraced ridge continues for about 700 m before joining the north-south trending ridgeline that overlooks the shallow lagoon. The Chometubet stream bounds Sisngebang's ridge north base while below to the east is Ngchemesed stonework village. Fresh water is also found in several small intermittent streams separating Ngchemesed village from the extensive Ngeskebei step-terrace complex and the terraced ridge of Ongelwatel.

5.3.1 Anthropological Background

Sisngebang was briefly surveyed by the Palau's Bureau of Arts and Culture (Olsudong et al. 1998:23). Ngchemesed stonework village was mapped during this same survey and by Krämer (1919). The surrounding terracing was noted from a boat by Osborne (1966: B14) and described by Snyder and Butler (1989:44–45). Contemporary elders do not recall how the area got its name nor any associated oral histories (V. Blaiyok, pers. communication, 2011).

Both Krämer (1919) and Hijikata (1993, 1995) visited the Ngchemesed area. Krämer (1919:150–152) mentions the “stupendous view” from the top of Sisngebang which he accessed from a 30 m high path from the west side. He states that there are no stories particular to Ngchemesed and calls the surrounding area a “wasteland.” Hijikata (1993:78, 239), writing

in the 1920s, briefly discusses Ngchemesed village and the savannah area (terraced) to the east, recounting that the inhabitants originally came from the Rock Island of Ngemelis:

The people of Ngeremetengel used to live on the island of Ngerecheu, and the people of Ngchemesed used to be on the island of Ngemelis. Back then, the people of Ngemelis were required to take *olaor* (driftwood) to Ngchemiangel as a tax. One day, the people of Ngerecheu stole it. The people of Ngchemiangel were angry and attacked the people of Ngerecheu and Ngemelis. The people of Ngerecheu escaped to the rock island of Ngerekhngong and created a village to settle down in at Ngeremetengel by paying some money to Imeiong. [Hijikata 1993:239]

Parmentier (1981:414–428) states that Ngchemesed was populated by groups migrating from Angaur, Ngemelis and Ngeruangel, a now-submerged atoll north of Babeldaob. Ilild is regarded as the original house and, according to Parmentier (1981:418), “the territory of Ilild covered all of what is presently Ngchemesed, including the vast unoccupied terraces east of the village.” He was told the people of Ilild are the children of Latmikaik who occupied the land before the migrations that resulted in the consolidated Ngchemesed village (Parmentier 1981:420, 422).

During the Japanese administration, roads were constructed into the area and much of the land was cultivated, including Sisngembang whose southern terrace displays planting furrows. In about 1979, Parmentier (1981:424) noted that Ngchemesed village was deserted with four semi-permanently occupied houses closer to the bay. Only one of these houses, at the end of the one-track dirt road leading from Ngaremlengui’s single paved road through the savannah to Ngeremeduu Bay, is currently inhabited.

5.3.2 Earthwork Description

Sisngembang is a unique earthwork complex and does not fit into any of the categories proposed in the earthwork typology (Chapter 4.1). Sisngembang’s earthwork components include the modified outcrop, a low earth crown, a gully, various forms of step-terraces, levelled areas, a berm, a stone facing and a basin. Step-terraces are cut into the ridge slopes with those descending the easterly incline down to Ngchemesed village later bisected to accommodate Palau’s only documented ancient stone staircase. Olsudong et al. (1998:21) identify the staircase place name as Orakl or ‘mast of a canoe,’ although the origin of the name

is not given. The steps, carefully constructed from rounded and cut basalt boulders, ascend from the village's main stone path and the *bai* to the levelled plain below Sisngebang's earth crown.

Despite the thick grasses, the scarcity of surface artefact scatters and stonework is noticeable.⁷ The only identified largely intact stonework are the remnants of a ca. 8 m wide modified bedrock facing⁸ descending the steep south side of the wide step-terrace below the Sisngebang outcrop. Cleared of vegetation, the facing would loom over watercraft entering the *taoch* below to land at the Ngerbai dock and to the inhabitants of the bay's margins as an extension of the Sisngebang outcrop. In contrast, the large facing is only observable to the limited number of the Ngaremlengui population that reside southwest of Sisngebang. Parts of a cobble facing remain embedded in the 4 m high riser west of the gully while parts of stone paving are on the earth crown and the levelled area to the southwest. The levelled terrain separating this crown from the descent to Ngchemesed village may contain a paving. These few paving remnants indicate Sisngebang likely supported structures. With a stonework village of a later era so near, it is probable that much of Sisngebang's stonework was relocated to construct the village features below.

With ca. 18 m high unscaleable vertical north and south sides, the outcrop's summit is currently accessed via the rocky seemingly unmodified east slope. Although its west side supports high step-terraces, vegetation is so thick that passage is currently difficult. The terraced summit measures between 10 and 15 m wide, 35 m long and has an azimuth of 135°. The summit is divided into three sections with the eastern third a ca. 9 x 12 m currently infilled basin rimmed by a U-shaped berm that, eroded from its originally built height, currently measures ca. 0.6 m high and 1.5 m wide. The western third is an 8.5 m long level area edged by a 0.3 m high and 3.0 m wide terrace on the west and a 0.6 m high rise to the central third on the east. The 12.7 m long level central third is capped with a 0.6 m high, 10.5 m long and 5.0

7 Due to semi-drought conditions a controlled burn of the site was not permitted; therefore, it is possible small, stone surface features may remain unrecorded.

8 The height of the facing could not be documented.

m wide berm on its east end that extends three-quarters of the way across the width of the summit and rises 0.9 m above the basin.

The construction sequence on Sisngebang's summit was interpreted from the excavations. The matrix on the summit's west side was removed down to the loose very gravelly disintegrating outcrop and placed to the east as construction fill. Additional fill material was hauled up from below.

5.3.3 Field and Laboratory Investigations

Sixteen stratigraphic trenches were excavated in the Sisngebang complex: five on the outcrop's summit (TRs 10–12, 15, 16), three in the wide terraces at the base of the outcrop (TRs 7, 17, 18), two on top of the earth crown (TRs 2, 5), two on the levelled area south of the earth crown (TRs 1, 4), and single trenches in the wide step-terrace on the earth crown's west slope (TR 3), the saddle between the crowns (TR 6), the berm in the northwest corner (TR 9) and the level area between the two (TR 8). Test units were excavated off the sidewalls of TRs 2, 11, 16 and 17 where a larger aerial view was needed for subfeature interpretation.

In addition to exposing five reconstructable pottery vessels, human burial pits, and a buried basin, test excavations produced samples for soil (n=6) and archaeobotanical (n=4) analysis, wood identification (n=15) and radiometric dating (n=8) of point-provenienced charred wood. Only data pertinent to the research themes are discussed here.

Human Burials

Human burials, identifiable by burial pits, almost entirely decomposed teeth and grave goods, were unearthed in the berm that crosses almost the entire width of the central section of the Sisngebang outcrop (Figure 40). The surface of three and possibly four burial pits were encountered at ca. 30–40 cmbs, below an A horizon (L. I) and berm construction fill (Ls. II, III; Figure 41). The pits rest on, rather than being cut into, a thin layer of levelled saprolite (L. V) overlying bedrock. Due to the relatively thin matrix available for subsurface burials, it is likely the berm was intentionally constructed to hold the burials.

The distinct oval burial pits are defined by very soft sediment identical in colour to the surrounding matrix. With some exceptions⁹, Babeldaob's acidic soils decompose human bone within about 50 years of interment (Liston 2010). The more durable teeth tend to preserve better than bone and, just as in the ancient burial complex in Ngaraard's Rois step-terraces (Tuggle 2007:341), were the only human skeletal element remaining in the pits.¹⁰

The Burial 1 pit, on the south, measures 0.6 m wide by 2.3 m long, is 0.4 to 0.5 m deep and has an azimuth of 134°. The north edge of the pit bisected a group of broken semi-articulated sherds. The remnants of a few teeth were found at the base of the pit's east end.

A distinct thin layer of red-stained or naturally occurring red sediment lines the base of the pit. The red sediment is not the same clayey consistency identified as underlying three sets of human remains in the Ngermereues Ridge cave burials (Rieth and Liston 2001:46). It is also not the same texture as the red sediment placed at the head and feet of a 45–55 year old male in the sand plain in front of Ngermechau settlement in Ngiwal (Ikehara-Quebral 2007). The stained substance has the loamy texture of the red matrix under one of 15 deteriorated burials in an *odesongel* (clan burial platform) in Ngerdubech stonework village (Liston 2011b:177). The cave burials are associated with radiometric bone dates of roughly 1000 to 1350 calBP¹¹ and the Ngermechau individual with a charcoal assay of ca. 200 years ago. The *odesongel* burial, without associated dates, is unlikely to be older than 800 calBP and possibly dates to the nineteenth or twentieth century.

The matrix underlying the interments could be staining from either a dyed mat wrapped around or under the body or from a substance, such as tumeric, applied to the body prior to burial (Rieth and Liston 2001:67). The ritual application of a red "paint" on the deceased's face and chest is noted by Miklouho-Maclay in 1876 (Parmentier and Kopnina-Geyer

9 These exceptions relate to burial practices affecting moisture, heat and soil chemistry.

10 Deteriorated human skeletal elements are also occasionally identified as a linear, white powdery dough substance.

11 Human bone was chemically pretreated with XAD resin protocol and a Delta-R of 0 was used in the calibration (Liston 2005).

1996:89). A half-century later Hijikata (1993:257) describes close relatives preparing a body for burial by putting:

a little *reng* (tumeric) on the deceased's lips after chewing it a little bit at a time. Then they purify the body with fragrant water called *bechochod*, created by boiling the leaves of *meradel* (orange) and *bekersiu* (a type of lemon). This is followed by putting *cheluch* (coconut oil) and *reng* on the body until it is absorbed.

The ritual use of turmeric oil is widespread in Oceania and Southeast Asia (Parmentier 1988:308) and, in Palau, symbolizes the family's great love and affection for the deceased (Palau Society of Historians 1995:42). Tumeric is naturally yellow or orange tinted but it may turn red when mixed with the iron-rich soils. Alternatively the burial was placed on a thin layer of naturally red volcanic sediment transported to the gravesite for the burial ceremony.

The Burial 2 pit, 20 cm north of the Burial 1 pit, is 0.7 m wide by 2.2 m long, 0.6 m deep, and is aligned at 132°. Small basalt cobbles and traditional pottery sherds are strewn across the east and west ends of the subfeature while an in situ and largely intact though rimless ceramic vessel rests on the subfeature's central surface (Figure 42, Figure 43). A single rim sherd lying in the broken vessel could not be articulated. Attributes such as temper, colour and firing appear to be identical and it is possible the two represent the same vessel. The pit fill contained no human remains or other significant cultural material, indicating that the skeletal elements had disintegrated.

Burial 2 truncated a third burial pit displaying the same characteristics and alignment as those documented. The excavation of graves on separate occasions explains the haphazardly placed stones, disarticulated sherds and the rimless vessel as subsequent burials would disturb earlier interments and their grave goods.

The graves appear to contain primary burials placed in an extended, supine position with an east-west alignment, parallel to the outcrop and perpendicular to the berm. It is clear that the cranium of one individual was placed to the east. The oval burial pits are large enough to suggest an adult interment. The red or a red-stained matrix underlying one individual indicates

the burial was accompanied by ritual. The only grave good encountered was a rimless pottery bowl although what food or other offering the bowl contained is not known.

A point-provienced sample of charred mangrove wood (cf. *Rhizophora* sp.) collected in the Burial 1 pit fill produced a radiometric date range of 1180–980 calBP (WK-28524; Table 18). The sample derives from a secondary deposition and does not necessarily identify the age the burial took place; however, it identifies a *terminus post quem* of ca. 1080 calBP for the burial event. Three of the remaining four radiometric assays on the outcrop overlap with the burial date, with the burial sample being slightly more recent.

Basins

Sisngebang contains at least two basins, one on the outcrop's summit and the other on the terraced landscape below. There is a strong possibility of additional basins buried beneath erosional deposits. The small size and the difficulty in accessing the Sisngebang basins suggests they could be of ritual or ceremonial importance possibly used in cultivation rites or to produce plants for use by high-status individuals.

A small constructed basin on the complex's south side, below the outcrop, contains marsh grasses. Surrounded by terrace structures, the ca. 7 m in diameter basin is cut into the back corner of a terrace tread with earth and bedrock risers ascending ca. 2 m from its north and east sides. A low berm encases the basin's south and west sides. The feature is filled with a roughly 60 cm thick deposit of very dark muck identified by the Palauan fieldcrew as the same fertile soils found in taro pondfields on the coastal margin. With a bedrock floor, and erosional material and rainwater draining into the feature from the slightly sloped terrain above, the basin's contents remain wet the majority of the year.

Sisngebang's second basin forms the eastern third of the outcrop's summit. An eroded ca. 1.5 wide and 0.6 m high U-shaped berm encloses all but the west side of the roughly 9 x 12 m basin. The remaining side is bounded by the 0.9 m rise to the central terrace and its capping earth berm. When originally constructed the berm was certainly higher and likely narrower. A

single east-west aligned test trench (TR 15) was placed in the basin next to the west side (Figure 44 and Figure 45).

The basin was constructed by removing the A and B horizons and levelling the underlying saprolite to slope slightly to the east. The material removed likely formed the berm edging the basin's sides. A 30 cm high cobble retaining wall, unearthed in the west end of the test trench, may line the base of the entire feature. The wall is formed from tightly stacked basalt cobbles embedded in and capped by a compacted construction fill (L. VIII). The original stonework may have been twice as high to entirely encase the compacted fill. Large pits or ditches (Ls. VI and IX) were excavated through the remaining saprolite and down to bedrock with the two unearthed measuring 70 and 80 cm in diameter and 25 and 45 cm deep. If they are ditches rather than pits, they are aligned perpendicular to the outcrop and the constructed slope of the saprolite. Both subfeatures are filled with a dark, gravelly, moist silty clay loam containing frequent charcoal chunks and few pottery sherds.

Once the basin on Sisngembang's outcrop was no longer of importance, it was infilled with ca. 60 cm of construction fill (Ls. II, III, IV), some overlying an erosional deposit (Ls. V, VII) that slumped over the retaining wall. Capping this is erosional material (L. Ib) originating from the summit's central higher terrace. The upper level of this matrix has developed into an A horizon (L. Ia). The quantity of erosion intruding onto TR 15's west side suggests that the burial berm on the higher central terrace may have been constructed, or reconstructed, concurrently with the infilling of the basin.

A deeply buried, truncated deposit (L. VII) in the west end of TR 11, on the west half of the central terrace, displays the same type of sediment found in the TR 15 pits (Figure 46, Figure 47). Only the edge of this deposit was exposed in the trench. It is highly likely it forms a basin area in the centre of the Sisngembang outcrop, just like the basin on the east side identified by TR 15. The dark, moist, gravelly silty clay loam contains charcoal chunks and flecks but is devoid of pottery sherds.

In order to accommodate the dark moist deposit (L. VII) in TR 11, the A and B horizons were removed with the C horizon alternatively levelled or stripped down to bedrock. The east edge of the pit is bordered by the cut B horizon (L. V). Layer VII is covered by up to 1.1 m of construction fill (Ls. XIV, XIII), an intact buried cultural horizon (L. IV), additional intentional fill material (Ls. II, III, XI, XII) and the current A horizon (L. I). Layer VII is also truncated, displaced (L. X), and partly covered by a pit (Ls. VI, VIII, IX) containing a pottery cache (see following section). The pit appears to be associated with the construction event covering L. VII that was placed in preparation for the L. IV cultural horizon.

Three radiocarbon dates were obtained from point-provienced charcoal samples collected in the three similar moist, dark deposits in TRs 11 and 15 (Table 18). A chunk of cf. *Cocos nucifera* collected in the TR 11 pit produced the earliest date range, 1740–1560 calBP (WK-28520), of the three. The two samples from TR 15 yielded sequential calibrated date ranges. The sample of unidentifiable woody taxon collected at the base of the retaining wall in the west pit (L. VI) produced a date range of 1385–1295 calBP (WK-28522) and the charred large-leafed mangrove (cf. *Bruguiera gymnorhiza*) in the east pit (L. XI) yielded a date range of 1270–1080 calBP (WK-28523).

No pollen was identified in the archaeobotanical samples collected from the TR 11 (n=1) and TR 15 (n=2) pits. This is not surprising given the pH range of 5.02 to 5.16 in the four soil samples from the outcrop's summit that were submitted for chemical analysis (Table 6).

Whole Pots and Pot Cache

Excavation in the summit of the Sisngebang outcrop unearthed a vessel placed as burial furniture in TR 16 and a cache of reconstructable vessels in TR 11. Another whole pottery vessel lay partly exposed on the earth crown below. Vessel attributes are presented in tabular form in Table 16.

An unrestricted round vessel was found in situ on the surface of the Burial 2 pit within the berm on the outcrop's summit (Cats. 265, 289; Figure 42, Figure 43). The largely intact yet

rimless bowl is approximately 51 cm in diameter, possibly 25–30 cm deep and 1.0 to 1.3 cm thick.¹² The vessel was fired in a reduced atmosphere and is coated in a largely disintegrated, brown, unburnished slip. The pot was disturbed post-deposition by subsequent burials so that its pieces are distributed across the adjacent surface. A flanged rim sherd, lying in the base of the vessel, may belong to this pot. If so, the rim is so large and heavy relative to the body that the vessel was likely for display or ceremonial use rather than utilitarian. The interior thickened rim is 3.4 cm thick at the flange and 1.0 cm thick at the base where it meets the vessel's body.

An intentionally placed whole ceramic vessel (Cat. 223) lay partly exposed in the eroded saprolitic surface on the earth crown below the outcrop. The unrestricted, round dish measures 25 cm in diameter and ca. 6 cm deep with 5 mm thick walls. The vessel was fired in a reduced atmosphere and displays fine-grained grog temper. Missing its rim due to erosion, it appears to have been straight-sided.

A pot cache composed of three reconstructable vessels and several single sherds was encountered in the middle of the central terrace on the outcrop's summit (TR 11; Figure 48). The cache lay in the upper layer of a pit feature (L. VI) buried beneath 40 cm of an intact cultural deposit (L. IV) and construction fill (Ls. II, III) capped by an A horizon. The pots were placed face down and seem to have been broken during the process of backfilling the pit as they were largely articulated. Each of the vessels was fired in a reduced atmosphere and is formed from the typical Palauan reddish-orange clay with medium-coarse grog temper. All three pots are painted, two are decorated and two display an annular base.

The most distinctive of the three reconstructable vessels is a decorated bowl with an annular base (Pot 1; Cat. 322; Figure 50). Pot 1 has a 28.0 cm diameter round opening, is 12.5 cm deep and is between 5.0 and 9.5 mm thick. The 7 mm thick rim is slightly incurving, straight-sided and has a somewhat thinner rounded lip. The annular base or foot measures 12.5

¹² Vessel form is defined by the relationship of the vessel's height to the diameter of its orifice. A jar is a vessel whose height is greater than its diameter. A bowl is a vessel whose height varies from 1/3 to equal to its orifice diameter whereas the height of a dish is between 1/5 and 1/3 of the vessel's diameter.

cm in diameter, 3.0 cm tall and 7.7 mm thick. Where the clay slab forming the foot was attached to the base of the already formed vessel it widens to 10 mm. The straight-sided foot displays a flattened lip. About 9 cm of the vessel's rim and half of the base is missing.

The interior and exterior of Pot 1 is painted a brick red; the exterior paint is more deteriorated, in part due to firing, and displays smoke clouds. The interior could have been painted after firing. Identical patterns of incised, 1.6 cm wide horizontal and vertical bands surround the upper rim. Three vertical bands, cut 1.5 cm below the lip and measuring ca. 13, 17 and 21 cm long, are separated by four horizontal bands that are at least 8.5 cm long. The horizontal bands start a few millimetres below the lip and appear to not extend to the base of the pot. An undecorated space of between 2.8 and 3.5 cm separates the vertical and horizontal bands. Two of the horizontal bands are adjacent to one another rather than split by a vertical band. The decorative motif, a re-occurring pattern of 'X' linked by a central raised line, was formed by cutting out the clay to create relief.

Annular bases are rarely encountered in Palau. A single footed vessel from Peleliu, Ngchesar, Melekeok and earthwork sites in Ngiwal and Ngatpang are documented by Osborne (1966:86, 1979:120-121, 146) and Liston et al. (2011:287). Osborne shows a photograph of a 14 cm in diameter and 5 cm deep pot base from the Peleliu 1 site (1966:80, Fig. 28b) and a "sherd with a possible ring base" measuring 1 cm deep he collected in the Ked ra Iklrong crown complex (NC-3:1; Osborne 1979:120, Fig. 88d). The Compact Road assemblage contains one certain and one possible footed base, both of which are dated to very early in Palau's chronological sequence. They are described as short and constructed from a ceramic coil. The Ngatpang vessel is associated with a radiometric date range of 2950–2760 calBP (WK-13972) while the Ngiwal pot is likely dated to about 1900 calBP.

Pot 2 is a round, unrestricted, painted but undecorated bowl (Cat. 323; Figure 50). The heavy, well-made vessel measures 26 cm in diameter, about 9.5 mm thick and is 11 cm deep. The direct, straight-sided rim measures 7.2 mm thick and exhibits a thinning rounded lip. The

interior and exterior are painted a brick red with the exterior surface colour marred by smoke clouds and dulled during the firing process. About 25 percent of the vessel is missing.

Pot 3 is a round, unrestricted, painted and decorated bowl with a short annular base (Cat. 324; Figure 49). The large bowl measures 34 cm in diameter and 16 cm deep. The body is 11 to 13 mm thick and the rim is about 7 mm thick. The slightly incurving rim thins to a rounded lip. The 8 mm thick foot is largely missing but it does not appear to be taller than a possibly 1–2 cm. Its interior, and possibly exterior, is painted brick red. Unlike Pots 1 and 2, the exterior of Pot 3 is flaking off in a “muddy” appearance first described by Osborne (1979:121–122). This may identify deterioration of a slipped surface (Desilets et al. 2007:30–31). A wide V-shaped impressed design circles the middle of the vessel beginning just below the rim and terminating 6 cm from the base of the pot. The motif is formed from parallel rows of oval impressions that together measure 1.4 cm wide. Each side of the V is roughly 13 cm long. About 40 percent of the vessel is missing.

A ^{14}C date derived from a large chunk of *Intsia bijuga* collected in the pot cache produced a calibrated date range of 1290–1170 BP (WK-28521; Table 18). Although there is no evidence of a burn lens, the prevalence of the large pieces of charcoal in the cache as opposed to the remainder of the trench suggests an association between the date and the deposition of the vessels.

5.3.4 Discussion and Sequence of Events

A provisional model of site formation and occupation of the Ngchemesed area is provided by using the five radiocarbon dates from the summit of Sisgebang combined with the three assays from the complex’s lower components and the 11 from the adjacent terrace sites of Ongelwatel (n=2) and Ngeskebei (n=9) (Table 18; Figure 39).

The Ngchemesed area occupies a prime location at the entrance into Babeldaob’s largest embayment offering defensive potential, storm protection and access to fresh water and bay and lagoon resources. This was likely one of the first permanently occupied areas on

Babeldaob. Due to the expansive view of the lagoon, bay and west Babeldaob afforded by its summit, Sisngebang was probably used early in Palau's cultural sequence for a lookout or signal tower.

Charcoal samples collected in two small pit features cut into saprolite in the Ngeskebei step-terrace complex below Sisngebang produced radiometric assays dating to 3380–3210 calBP (WK-28515) and 3260–3000 calBP (WK-27001). These are the earliest archaeological dates collected within earthwork complex cultural deposits.

A very dark reddish brown (5YR 2.5/2) intact cultural deposit in the wide step-terrace at the north base of the Sisngebang outcrop produced a calibrated date range of 2770–2700 BP (86.2%), 2640–2610 BP (6.5%), 2590–2540 BP (2.7%) (WK-28518). The associated terrace is sufficiently large to support a structure and the 18 cm thick deposit, close to the terrace's outer length, is tentatively interpreted as representative of repeated sweeping out of the adjacent structure. Alternatively, the lens may be a remnant of the initial occupational horizon that was truncated during subsequent use and feature construction. The identification of the charred wood as cf. *Bruguiera gymnorrhiza* shows the burn did not derive from vegetation clearing associated with initial site activity.

Construction fill associated with the first large scale construction event on the adjacent terraced Ongelwatel ridge contains the charred remains of cf. *Artocarpus altilis* that yielded a ¹⁴C date range of 2490–2330 calBP (WK-27009).

Although in use earlier, the five radiocarbon assays from Sisngebang's crown outcrop indicate that initial shaping of the summit occurred by at least 1740–1560 calBP when the A, B and C horizons were stripped to accommodate TR 11's shallow pit feature that rests on bedrock. The dark moist pit may have been a ceremonial or ritual cultivation plot, although the acidic soils preclude identification of cultivars or special soil amendments. An assay of 1530–1380 calBP (WK-26998) on a cf. seed embryo collected in construction fill in Ngeskebei indicates simultaneous occupation of the two sites.

The east end of the Sisngebang summit was shaped into a basin by removing the A and B horizons and levelling and sloping the saprolite to accommodate pits, or ditches, by at least 1385–1295 calBP (WK-28522) / 1270–1080 calBP (WK-28523). The pit matrices in the basin highly resemble that identified in TR 11 and likely had the same basic function. The basin's bounded space is in a difficult to access and a conspicuous elevated location. It is reasonable to assume that the basin contained ritual or ceremonial cultigens used in offerings or by the elite.

Very few basins have been excavated. The Tabelmeduur basin contains bowl-shaped depressions, some with angular tiers, with one edge formed by an open-sided pit or ditch perhaps used in channelling water (Liston 2008). Gleyed and ironstone deposits identify standing water in the Ngemeduu (Phear 2007) and Ngedelchong basins. A ditch emptying into some basins, such as at Tabelmeduu and Site NM-4a would empty rainwater into the feature.

Concurrent with the activity in the basin was the placement of a pottery cache on the summit's now elevated central terrace. Although no human skeletal material was associated with the cache, it may be associated with a burial or it could be associated with a ritual event tied to the basin.

Four assays in the Ngchemesed area overlap with use of the basin and the pot cache. Radiocarbon dates of 1300–1170 calBP (WK-28519) from a small pit and 1180–980 calBP (WK-28517) from an intact cultural deposit in the terraces in Sisngebang's lower floor shows the entire complex was occupied. Charcoal samples from two large pits, one a garbage dump, cut into the saprolite in the Ngeskebei complex produced a combined calibrated date range of 1280–1070 BP (WK-27003, -006).

The extent of erosion intruding onto the west side of Sisngebang's basin suggests that the burial berm on the higher central terrace may have been constructed, or reconstructed, concurrently with the infilling of the basin. One of several burials in the berm dates to 1180–980 calBP (WK-28524). The complex stratigraphy and the disturbance to cobbles and sherds (potentially once whole vessels) in the berm indicate the interments occurred over a

period of time rather than as a single event. This assay on the burial pit is the most recent of Sisngebang's dates.

A roughly 500 year gap in Ngchemesed radiocarbon dates is likely due to lack of archaeological excavations in the stonework village of Ngchemesed rather than abandonment of the entire area. Construction of Palau's stonework villages may not have begun until about 700 BP. Some form of earthmoving continued on Sisngebang as the most recent dated deposits (1180-980 calBP, WK-28517) in the lower floor of the complex are buried in construction fill, none of which were radiometrically dated. Although this remodelling likely occurred in traditional times, there is evidence of Japanese Era use of Sisngebang's lower floor.

The five overlapping ^{14}C dates from the Ongelwatel ridge and Ngeskebei step-terrace complex indicate they were both heavily occupied and reconstructed between 545–260 calBP, during the Stonework Era. At this time, both complexes contain stone pavings associated with structures identified by postholes. The Ongelwatel paving was constructed at 510–420 BP (49.9%), 410–310 BP (45.5%) (WK-27008) on top of an intentionally placed whole pot (Figure 51, Figure 52). Placing a complete vessel beneath a constructed element, in this case stonework, is consistent with the intentional insertion of whole pots beneath earthwork components that extends far back in Palau's history (see Chapter 9.4).

Ngchemesed stonework village would have been occupied at this time and Ngeskebei may have supported dryland fields that sustained the village population. If the stone staircase leading from Ngchemesed to Sisngebang was constructed through the pre-existing step-terrace slope at this time then Sisngebang was still significant to the community.

The Sisngebang outcrop and its lower terraces were used concurrently. The outcrop's summit may have been a look-out soon after colonization although this activity would not necessarily produce material for dating. The site's lower floor was occupied by about 2700 years ago and by at least 1700 BP the summit was being significantly modified, perhaps to support a ritual cultivation plot. This ritual activity expanded and continued over the next five

centuries with the construction of a bermed basin also interpreted as potentially growing plants used in a ceremonial context.

The significance of the Sisngebang summit at this time is exemplified by the pot cache containing unique footed, painted and decorated vessels. Burials, likely of high ranked individuals, were placed in a specially constructed berm beginning at least 1150 years ago. The burials were accompanied by grave goods contained in large pots dedicated to the event. Use of the summit may have ended soon after this although it likely continued to at least serve as a look-out point or signal tower until the recent past. Construction of a stone staircase leading to the summit shows the significance of Sisngebang to the population living in Ngchemesed.

5.4 Ked era Aranguong

Twelve stratigraphic trenches were excavated at Ked era Aranguong. Ked era Aranguong is part of the continuous earthwork landscape behind the mangrove forest lining both banks of the Ngermeskang River in Ngaremlengui (Figure 2, Figure 53 and Figure 54). The large earthwork complex, on the river's west bank, is shaped onto a wide U-shaped ridge. Largely savannah covered, the terrace system continues to the west under upland forest. To the north and south, the terraced hill and ridge system falls to wetlands before rising to more terraced hills.

The Aranguong savannah measures about 400 by 500 m with an azimuth to the northeast and climbs from sea level to 50 m amsl. Bounding all but the west side of the complex are Mesei-Dechel-Ngersuul map unit soils that support ca. 5 ha of freshwater marsh species, and on the southeast side, swamp forest. Secondary upland forest is encroaching onto the savannah from the west. The Ngermeskang River flows within 40 to 150 m of the forested portion of the complex's east side while one of its tributaries slices through the wetlands to the north. It is likely that during the Earthwork Era, Aranguong looked directly out over the river rather than the current thick mangrove forest.

5.4.1 Anthropological Background

Ked era Aranguong is within the ca. 486 ha Asahi Mura agricultural plantation, one of three plantations established in the highly fertile ca. 80 km² Ngermeskang watershed during the Japanese administration. Scattered World War II foxholes and planting furrows lining the site's swale identify the Japanese presence. The 1984 USGS topographic map has a mining symbol on the site; however, the 1921 Japanese vegetation map, the 1942 and 1954 USGS topographic maps, the 1946 aerial photos and the current savannah display no evidence of mining activity. This land between the high mountains of Rois Mlengui and the Ngermeskang is currently uninhabited and only accessed by hunters and those collecting wild plants.

A Ngaremlengui elder identified the savannah containing the earthwork complex as Ked era Aranguong and the adjacent one to the southwest as Ngemkeang. Lucking (1981:73) lists the complexes as Iterir and Skemesuk, the names of two clans from the nearby abandoned stonework village of Ngesisech. She suggests both complexes are traditionally associated with that village which is in concurrence with Parmentier (1981:328, 630). However, Parmentier (1981) appears to identify the larger Ked era Aranguong area as Rrangchuong, a satellite village to the central village of Ngesisech in the former subdistrict or federation (*renge*) of Kleuidelngurd (Seven Ridges). In a traditional history related by Hijikata (1993:228), people from Iterir wanted to climb a betel nut tree in Ngesisech that reached the heavens. Currently, Ked era Aranguong is within the Imeong traditional village area.

Although mentioned by Snyder and Butler (1989:51), Lucking (1981:73, NM:8) and Olsudong et al. (1998:74), Ked era Aranguong has never been archaeologically investigated.

5.4.2 Earthwork Description

The Ked era Aranguong complex is formed on a wide U-shaped ridge opening to the east, towards the Ngermeskang River (Figure 54). The interior of the U forms a ca. 160 m in diameter swale that gently descends to a fresh water wetland bordered on its opposing side by the mangrove forest leading to the river. The swale contains a mix of deep and wide step-terraces that are truncated by a steep central and two smaller gullies draining into the swamp.

The curve of the U is a ca. 40 m in diameter levelled hill whose summit provides a 180° easterly view across the entire complex, nearby earthworks, the Ngermeskang River and out over the forested terrain to the Rael Kedam. The north- and southwest slopes of the hill are cut into step-terraces and the shaped ridge leading to the west side connects to the Ngedelchong crown complex.

Extending out of the north- and southeast sides of the levelled hill are the curving ridgelines that slowly descend in low, deep step-terraces for about 580 m to the south and 340 m to the north. The ca. 15 m high slopes of the 20 to 35 m wide ridgelines, occasionally falling almost sheer to the swale, are generally cut in high, wide step-terraces. The final roughly 100 m of both ridgelines is vegetated in secondary forest. Towards the end of the north arm is a ditch and levelled hilltop. Just past a low saddle terrace on the south arm, the ridge splits in two with both extensions displaying shallow and wider step-terraces.

Basalt boulders and large cobbles form disturbed but sizeable pavings that are widely dispersed throughout the complex. Most extant stonework is east of the south ridge's saddle terrace. Here remnants of a stone path line the interior edge of the ridge, lead east down the split and may continue on to the Ngermeskang River. Before being removed for re-assembly in nearby villages, the Ked era Aranguong complex likely supported more stone features. Pottery sherds and CCS debitage are commonly found eroding down the steep slopes rather than on the surface of the ridgelines.

5.4.3 Field and Laboratory Investigations

Twelve stratigraphic trenches were excavated at Ked era Aranguong. The taxon of seven charred wood remains were identified with six of these being submitted for radiocarbon dating (Table 18). Three soil samples underwent chemical analysis and one sample was analysed for archaeobotanical remains.

The excavations exposed a heavily modified landscape with stripped and levelled basal matrices capped by construction fill and few identifiable intact habitation deposits. Trenches in

the swale revealed deep erosional deposits beneath topsoil produced by Japanese Era agricultural activities. Soil analysis identified the typical highly acidic soils found throughout Babeldaob's volcanic landscape. Archaeobotanical processing of a soil sample recovered in one of two parallel ditches in a gully in the swale documented a pollen assemblage whose taxa have not been identified (TR 9, Cat. 479).

Trench 9 was excavated in and perpendicular to a gently sloping, shallow gully in the terraced swale's southeast quadrant. The trench exposed two adjacent round-bottom pits that are likely segments of parallel ditches. The subfeatures cut into the basal saprolite and extend the width of the trench, hence parallel with the gully (Figure 55 and Figure 56). The subfeatures measure between 0.5 and 0.6 m wide, 0.5 m deep and are spaced 1.1 m apart. Both subfeatures are filled with an erosional matrix (L. IV) containing little cultural material beyond charcoal flecking. Layer IV rests directly on the cut basal saprolite indicating that the A, B and some of the C horizon were removed when the gully was shaped. The abrupt termination of Layer IV at the north edge of the north pit (SFea. 1) may signal the edge of the originally constructed gully. The subfeatures are covered by 40 cm of erosional deposits (Ls. II, III) that could date to different occupational horizons each of which restructured the earthwork complex. The gully is capped by the Japanese agricultural layer (L. I).

The pit features appear to be ditches cut into the length of the constructed gully and lead to the swamp about 30 m to the east. Like the similar set of subfeatures unearthed in the Nkebeduul earthwork complex (Site NM-7:j1), the ditches are interpreted as drainage channels placed to control and direct water flow. The ditches would help drain water away from the habitation areas on the ridgelines and into field systems in the swale before emptying into the wetland. Although requiring paleoenvironmental data before it can be proven, it is highly likely the swamp was a cultivated pondfield very early in Palau's cultural sequence.

An unidentifiable woody taxon collected in the erosional fill in the south ditch produced a radiocarbon date range of 1400–1300 calBP (WK-28529). The sample was chosen for analysis to assist in identifying the point after which the first erosional event that infilled the gully

occurred. However, the resultant assay is so early that the data provides little information and must be placed in context with the assays from the site. The gully could have been infilled anytime after ca. 1200 calBP.

Trenches 2 and 8 excavated off the east side of two stone pavings on the south ridge's step-terraces revealed two ca. 1.5 m diameter and 60 to 75 cm deep pit features cut into saprolite. An unidentifiable woody species strewn about the floor of the TR 2 pit rendered a radiocarbon date range of 2120–1920 calBP (WK-28525). The charred remains of cf. *Bruguiera gymnorhiza* associated with a layer of broken sherds unearthed in TR 8 yielded a calibrated date range of 1830–1690 BP (88%), 1670–1620 BP (7.4%) (WK-28528). Both pits are filled with erosional material but whereas the latter subfeature is covered by an A horizon, the former is capped by a construction fill matrix, a thin intact living surface and the current A horizon.

Trench 5, on the north edge of the south ridgeline, unearthed two intact living surfaces (Ls. II, IV) separated by a layer of construction fill (L. III) (Figure 57 and Figure 58). Both living surfaces contain post moulds, pottery sherds and substantial amounts of charcoal. The lower cultural deposit (L. IV) lies on a levelling layer (L. V) composed of a mix of the B and C horizons. The remaining B horizon and parts of the basal saprolite were removed during the earthwork construction process. A charcoal sample retrieved from a thick lens of burned *Areaceae* produced a ^{14}C date range of 1710–1550 calBP (WK-28527). A 20 cm thick layer of construction fill on the lower occupational surface indicates a period of earthwork reconstruction and possibly a period of abandonment before the next occupation. An unidentifiable woody species collected in TR 5's upper living surface produced a radiocarbon date of 735–670 calBP (WK-28526).

5.4.4 Discussion and Sequence of Events

The Ked era Aranguong earthwork complex was likely occupied by those who cultivated the central swale and the adjacent freshwater wetlands. The floodplains of the Ngermeskang River are some of the most fertile lands on Babeldaob. Fertile soil, along with the ease of

access to the bay and lagoon via the river, would make this prized land for Babeldaob's earliest settlers. Ked era Aranguong is also well protected from storm events and invading enemies due to the distance to the coast and the high hills and ridgelines ringing the site.

Ked era Aranguong could have been occupied as early as the calibrated radiometric assay of 2500–2340 BP (80.8%), 2690–2630 BP (12%), 2620–2590 BP (2.6%) (WK-28530) produced from a sample of charred cf. *Glochidium* species. The sample was collected in the basal erosional layer of the swale's central gully (TR 11) and could be reflective of deforestation for swidden agriculture. Although not collected in an intact cultural deposit, the early date is entirely feasible given the location of the site in the larger landscape.

By about 2000 years ago, large pits cut into saprolite on the now levelled ridges indicate the landscape was being shaped to suite the inhabitants. Certainly associated with earthwork construction and use, exactly what the pit's associated activity is can not be determined. The intact living surface exposed on the edge of the terraced ridge, overlooking the swale below, suggests the Ked era Aranguong complex was constructed, inhabited and being cultivated by certainly ca. 1650 BP, and perhaps long before as the other radiometric assays suggest. It is likely the site was one of many dispersed habitation and cultivation areas placed on the ridgelines surrounding the Ngermes kang River.

The stonework dispersed throughout Ked era Aranguong may be associated with this early settlement. The stone path edging the south arm of the ridge lacks the more recent addition of a central stone alignment suggesting it was constructed before the Stonework Era. This architectural style is in accord with the associated pavings. Raised stone platforms, rather than pavings whose stones are relatively flush to the surface, are also a later architectural development. The same type of early architecture, dispersed across a complex arrangement of step-terraces, levelled ridges, crowns, gullies and other earth structures, was identified in the undated Ngermes kang village located east of the river.

Due to its fertile soils and prime location, the complex was either continuously occupied through the Transitional Era or re-occupied at the beginning of the Stonework Era at about 700

calBP. At this time, wetland cultivation was likely still an important site function but habitation may have been patterned differently with farmers making daily forays to the cultivated fields from a central stonework village, perhaps the nearby village of Ngesisech.

5.5 Ngedelchong Crown

A single stratigraphic trench was excavated in the level surface of the Ngedelchong crown (Site NM-3:j1). The Ngedelchong¹³ crown caps a modified ridge in the earthwork landscape extending west beyond the Ngermeskang River (Figure 53). The ridge, cut into causeways, step-terraces, and levelled areas, leads 270 m northwest to Ngesachel, a distinctive Type IIIa earthwork complex, and 400 m east to the Ked era Aranguong hilltop. Ngesisech stonework village, abandoned about a century ago, lies just to the south. Except for the high grasses on the deep step-terrace tread skirting the crown's east side, the complex is covered in thick secondary forest growing in the Aimeliik-Palau soil unit.

The crown takes its name from the surrounding area's place name. There are no known oral histories about the site or the nearby terrain and the earthworks have never been archaeology investigated.

The 24 by 32 m crown has an elevation of 80 m amsl and rises 4 to 9 m above the modified ridge to the east and west and the high, wide step-terraces to the north and south. The crown's summit provides an observation post over the Ngermeskang River and its tributaries. The view extends east to the central ridge, the Rael Kedam, and north and south down the centre of the island. West, towards the coast, the line of sight is blocked by the high Ngesachel ridge system.

Now eroded, it appears that the crown's south slope was paved. If so, it is likely the east and north sides of the crown were also paved, as this would be a prominent marker on the landscape to those in the Ngermeskang River valley. The west side need not have been paved as it does not overlook but connects back into the Ngesachel ridge.

¹³ The crown is also referred to as Tengatel but as the informant could not go into the field, this place name may refer to another hill.

A stone paving lies buried in the levelled ridge at the crown's west base and remnants of several stone pavings and paths are found as the ridge continues to the west. A 0.5 by 1.5 m monolith of shaped columnar basalt lies on the centre of a small paving on the terrace tread at the crown's south base.

5.5.1 Field and Laboratory Investigations

A single stratigraphic trench was excavated in the summit of the Ngedelchong crown (Figure 59 and Figure 60). The 6.5 m long, east-west aligned trench was placed just south of the crown's centre. Excavation descended to between 1.6 and 1.9 m below surface, into basal saprolite, and encountered a complex stratigraphy composed of 12 layers, most with sublayers. Laboratory work included identification of five wood samples, four ^{14}C dates and analysis of a single soil and archaeobotanical sample.

Basin

The west half of the trench revealed the east end of a shallow basin that held standing water. The basin measures at least 6 m long and 0.6 m deep although with bermed sides it would be substantially deeper. The basin appears to be constructed in the centre of the west half of the crown on construction fill (L. VI) resting directly on cut saprolite (L. VII). The basin's wavy lower boundary displays narrow pointed pits that may be digging stick (*ongereuakl*) impressions or, less likely, post moulds from a structure built over the subfeature.

Two matrices, not found elsewhere in the excavation unit, remain in the basin. The upper layer is an 8–13 cm thick dark gray (5YR 4/1) gleyed clay containing some faint red streaking (L. IV). This deposit caps a distinct 15–25 cm thick gravelly yellowish-red (5YR 4/6) silty clay (L. V) whose sharp lower boundary is often defined by red and black ironstone formations composed of the typical red crust of oxidized iron. Both deposits contain scattered sherds and charcoal.

Layer IV and V's physical characteristics are clear indicators of a long period of standing water. Chemical analysis of the gleyed sediment (L. IV; Cat. 463) did not produce evidence to

identify a specific use or soil additives. As might be expected in long undisturbed acidic soils, the sample's chemical composition is not significantly different from the other analysed units of volcanic soils. Preliminary archaeobotanical analysis of Layer IV identified a countable pollen assemblage (Cat. 462) although the taxa have yet to be identified.

A roughly 60 cm high wall of intact saprolite separates the basin from activities on the east half of the crown. The 'wall' was likely capped by a berm that deepened the basin and has since eroded into Layers VII, VIII and IX.

Charred remains of cf. *Rhizophora* sp. collected in the bottom of the basin (L. V) beneath the gleyed surface produced a radiometric date range of 2120–1900 calBP (WK-28531; Table 18).

Pits

In the east half of the trench the paleosols were removed and the basal saprolite cut to slope about 20 cm deeper than the basin. Fifteen different fill layers or pits (Ls. Xa-Xm, XI, XII) form a ca. 1.3 m thick and >2 m long deposit resting on the prepared saprolite surface. At least three more large oval and round pits were identified in the floor of the trench during excavation. The entire deposit rises between 10 and 20 cm higher than the surface of the basin but does not extend higher than the berm.

The stratigraphic trench was widened on its south-central side in an attempt to track the sequence and alignment of the fill subfeatures and to differentiate between pit fill and more general construction fill. However, it was not possible to make these distinctions without opening additional units; a task impossible to accomplish in the remaining field time.

The fill deposits have distinct sharp lower boundaries, are formed from various mixtures of B and mottled C horizons, are relatively compact and are distinguished by variations in colour and quantity of mottling. Some layers extend across the floor of the excavation unit, others are found only on one side of the unit. The majority of the pit and fill deposits contain very sparse pottery sherds with many entirely sterile of cultural material. A large quantity of

unarticulated traditional pottery sherds, that do not form a reconstructable vessel, was conglomerated in the lower half of Layer XI.

These fill matrices are too large and clearly shaped to be a result of individual baskets dumping construction sediments. There is not enough mixing or truncating of the layers to suggest repeated excavation and backfilling and there is not an identifiable stable surface indicating an occupation horizon.

The sequence of the fill deposits begins with Layer XII, followed immediately by Layer XI, then Layer Xi, and Layer Xb. Later, Layer Xb was truncated to accommodate Layer Xh, which was then covered with Layers Xf and Xg. Except for Layer Xb, each of these matrices continues to the east and may be much larger. The entire deposit was covered with Layers Xa, Xc, Xd and Xe.

Overlapping with the assay in the bottom of the adjacent basin, is a ^{14}C date range of 2010–1870 calBP (WK-28534) from an unidentifiable woody species collected in a small pit in the base of Layer XII. Charred cf. *Glochidium* sp., associated with the sherd conglomeration in Layer XI, rendered a radiometric assay of 1900–1730 calBP (WK-28532).

Capping Event

Covering both the basin and the pit and fill units is an up to 40 cm thick construction fill deposit (L. III). The fill material appears to have been placed to level and cover the crown to prepare for either site re-occupation or a change in site function. It is not thick enough to substantially elevate the crown. Above this is a thin intact occupation deposit (L. II) defined by a darker silty clay containing scattered sherds and charcoal and no construction fill. This is capped by the current A horizon (L. I).

Where the basin meets the pit and fill units, originally separated by a 60 cm high wall of basal saprolite, a set of deposits (Ls. VII, VIII, IX) bisect both the construction fill (L. III) and the occupation deposit (L. II). This set of deposits is interpreted as the remnants of the berm that spread out through erosion and trampling during the construction event represented by

Layer III. A sample of cf. *Parkia parvifolia* collected in Layer II yielded a ^{14}C assay of 470–300 calBP (WK-28533).¹⁴

5.5.2 Discussion and Sequence of Events

Due to providing such a clear view over the Ngermeskang watershed, the Ngedelchong hill may have been first used as an observation point. This would not necessarily require any shaping of the terrain. However, with an almost 40 m gain in elevation and affording an almost 360° view from its summit, the Ngesachel ridge system immediately to the west is in a substantially better location for an observation post or signal tower. It is unlikely Ngedelchong would be used before the Ngesachel crown, and when it was occupied, it likely was to fulfil a purpose not undertaken by its more prominent neighbour.

Initial construction activity on Ngedelchong may have simply levelled the surface. The first recognizable cultural activity is the removal of the A and B horizons and cutting and shaping of the C horizon across the hilltop. This generated a substantial amount of construction material to elevate or shape nearby earth structures. The fill may have formed a berm around the shallow depression cut into the saprolite on the west side of the hilltop to create a deep basin. A radiocarbon date from the base of the waterlogged deposits in the basin shows that the feature was in use by at least 2000 years ago.

The basin's small size and largely inaccessible placement on an elevated structure make it an ineffective water catchment. It is more likely the basin served as a ceremonial or ritual cultivation plot used by priests or high-ranking individuals. The cultigens, medicinal plants or ornamentals produced in the basin could have been dedicated for use in ceremonial or ritual events or for the consumption or use by the upper class.

Concurrent with construction and use of the basin is the lowering of the crown's east side and the placement of the first of multiple pits and fill material. The lack of lenticular fill identifies the multiple pits and fills as associated with an event other than the construction

¹⁴ *Parkia parvifolia* is endemic to Palau and currently very rarely found, generally limited to a few locations in Ngaremlengui (A. Kitalong, pers. communication, 2011).

process. Due to the high level of activity, it is highly probable that the hillslopes were carved into steep sides in tandem with the complete alteration to the hilltop.

The sequence of events reflected in the east side's complex strata is uncertain. As the oval and rectangular deposits superimpose and intersect similar deposits, their deposition does not appear to have occurred in a single episode. Oval pits on a crown suggest human burials. No intact human skeletal material or linear whitish dough identifying highly disintegrated bone was identified. A long lens of red clay or red-stained deposits sometimes associated with interments or what could be interpreted as grave goods were also not unearthed. Regardless, it is possible that the complex stratigraphy represents multiple human burial events. If so, the two radiometric dates from the lowest pit deposits identify the initial burials events as occurring 2000–1900 years ago.

The duration of crown use in its original ceremonial or ritual capacity and when, or if, it was deserted for a period of time can not be determined without additional excavation. As the surrounding terrain contains earthworks as well as villages from the later Stonework Era, it is likely Ngedelchong crown had a long occupational sequence. Remodelling of the crown that covered the basin and the series of pit and fill deposits occurred at least 300 years ago and possibly much earlier. Covering these older features signifies that they were no longer needed in their originally created capacity. There may have been a period of site abandonment prior to the remodelling in which the meaning of the basin and pits were forgotten.

The lack of cultural material in Layer II, the final occupation deposit, suggests that site use after the basin and pit series was covered was infrequent. The crown's summit during the latter centuries of the Stonework Era may have only served as an observation post or signal tower on specific occasions. However, the effort required to level the crown's surface with the Layer III fill suggests that there was an incentive to the construction event beyond intermittent site use. It may have been to cover the prior activities and establish the new dominant ideology.

5.6 Roismelech Crown Complex

A large bulldozer cut was faced and profiled at Roismelech (Site ME-4:3), one of a continuous set of earthwork complexes lining the coastline of Melekeok state in east-central Babeldaob. This chain of low terraced hills is backed by barren badlands and fronted by a truncated band of wetlands leading out to a narrow strip of sandy beach. The Roismelech crown complex is archaeologically distinguished by its unusually deep ditch on the coastal base of the crown and a coral-faced step-terraced ridge slope.

Roismelech rises some 60 m above the currently inhabited village of Ngeremelech on the shoreline 300 m to the east. All but the savannah covered west end of the complex is vegetated in thick secondary forest growing in the Aimeliik series soils. Part of the complex was disturbed by Japanese Era cultivation and construction of World War II defensive features.

At the base of complex's east side, along the narrow coastal road are a set of stone faces (*klidm*)—the largest of which is Odalmelech (Figure 61). Their formal and stylistic qualities distinguish them as the oldest of the four chronologically sensitive *klidm* types identified by Van Tilburg (1991). Although she was unable to date the stone monoliths, she did note they became progressively less abstract to culminate with the type represented in Figure 62. According to Hijikata (1993, 1995), *klidm* are gods or symbolic representations of mythic beings that were relocated from their original location in the hills to coastal locations with the most recent settlement pattern. One *klidm* with the same stylistic affinities as Odalmelech lies face-up on the Roismelech crown.

5.6.1 Anthropological Background

In traditional history, ancient Melekeok was founded by Chelebuul (poverty), a descendant of the giant clam Latmikaik. Later Melekeok became one of the goddess Milad's four children and the ranking village in the Ngetelngal polity encompassing the current states of Melekeok, Ngiwal and parts of Ngchesar. As the capitol village of Palau's two traditional village confederations (*bitaleanged* or "half of the sky"), Chief Reklai of Melekeok is one of the High Chiefs of Palau.

Settlers near Roismelech migrated with Chief Secharuleong after fleeing a man-eating centipede in Ngeremdiu village on the Rock Island of Ngeruktabel (Hijikata 1996:109–113; Tellei et al. 2005:45–46). After first landing in Medorm village in Aimeliik, the group journeyed on to coastal Melekeok and named the area Ngeremelech, after their neighbourhood in the Rock Islands. Odalmelech, represented by the *klidm*, is Secharuleong's family god and his home, Roismelech, is considered a "holy place" (Hijikata 1993:80–81, 1996:76–78).

Hijikata (1996:76–81) tells the legend of how the coral stones found on the central terraced slope of Roismelech's east side and the *klidm* came to be on the hill:

Odalmelech, a god of Roismelech, was labouring on the construction of Roismelech with Ngirengchesar, a god of Ngchesar. At that time, a group of people from Beliliou who were going to build Badrulchau walked by. Odalmelech asked them to help him build this place first and then go to the other places after Roismelech was completed. So, some of these people went up and helped to build Roismelech. When the *tutau* and the rooster sang and dawn came—in Palau, it was believed the era of gods was dark—the people were turned into stones in the middle of the work and were raised up to heaven. According to the legends, they became the stones Orrengesachais, Mengachui, Chiuaiu, and others. [Hijikata 1993:73]

Hijikata (1993:73) speculates that this is a recent legend and does not relate to Roismelech's meaning or significance during an earlier period, now considered the Earthwork Era. Tellei et al. (1998b:203) tell a slightly different story of the hill's creation in which six gods built a *delengobel* (closed area) atop Roismelech and planned to live below in what is now Ngeremelech village.

Roismelech was archaeologically investigated by Osborne (Site B-37B, 1966, 1979), Blaiyok and Metes (1989), Snyder and Butler (1990), Lucking (Site ME:2, 1981) and Hijikata (1993).

Osborne (1979:138–141) placed a series of test units down Roismelech's east and north ridge slopes, several apparently directly on the step-terrace excavated in this study. Beneath the humic mat he encountered a "thin 6 to 9 cm thick reddish clay zone" over a sterile clay he considered saprolite in which he terminated his units. Lucking (1981) identified intact saprolite 30–40 cm below the surface in her units near Roismelech and agreed with Osborne's analysis of a simple regional stratigraphy. However, as shown in the current investigations, their

excavation units terminated in a thick layer of construction fill that was misidentified as an intact C horizon. Distinguishing between the two is extremely difficult when the only material used in construction fill is the heavily variegated saprolite.

5.6.2 Earthwork Description

Roismelech's slightly oval crown measures roughly 8 m high by 20 m in diameter. It is outlined with a low berm and capped by an eroded knoll and a small coral paving (Figure 63). The berm suggests that the crown contained a now infilled basin. The crown's east and west faces fall steeply to ditches; the one on the east is particularly deep at about 2 m. To the north and south levelled ridges are shaped into deep step-terraces. A multi-ditched ridge extends to the west and deep step-terraced ridges separated by narrow gullies descend the east slope towards the coast. The east central ridge contains an abundance of coral cobbles that may have once formed facings or pavings although some of this coral must have been tossed off the crown during the Japanese Era. In the 1920s, between 99 and 132 m² of the crown's surface was covered in coral (Hijikata 1993:72). As this area is larger than the summit, Hijikata (1993) may have included the coral-covered terraced ridge in his calculations. There is very little coral remaining on the crown's surface.

The 23 m wide and ca. 35 m deep step-terrace investigated here is the uppermost of the east-facing terraced ridge between the paved road to the north and the coral-covered ridge to the south. The step-terrace is bounded on the west by the crown's deep ditch and to the south by the gully separating it from the coral-covered ridge. The deep step-terraces descending to the paved road on the north are truncated by a concrete driveway leading to the new house constructed on the step-terrace under investigation.

5.6.3 Field and Laboratory Investigations

In 2008, before building a house on the step-terrace, landowner Selma August lowered the earth structure by about 4.5 m. Bulldozer operators encountered at least three prepared surfaces outlined in coral cobbles, some supporting upright whole pots, close to the base of

their excavations (Figure 64).¹⁵ Archaeologists from Palau's Bureau of Arts and Culture (BAC) photographed and collected the whole pots from the prepared surface on the southwest end of the step-terrace (Subfeature 1). Construction workers finished removing all but a 2 m thick section of the step-terrace's west end to leave a roughly 4.5 m high east-facing stratigraphic profile.

According to the landowner, this wall profile is within about 30 cm of the now destroyed Subfeature 1. In 2010, Liston faced and profiled the south half of the still-standing terrace remnant to identify the stratigraphic sequence and collect charcoal samples for ¹⁴C dating. Two samples of charred wood were submitted for wood identification followed by radiometric dating and two of the vessels previously collected by BAC were analysed.

The profile reveals a deeply buried levelled basal saprolite containing post moulds and the west end of a shallow pit (Figure 65 and Figure 66). This is covered by an intact cultural deposit (L. V) that slopes gently towards the terrace's central width. Layer V contains significant amounts of charcoal chunks, traditional pottery sherds and coral and basalt cobbles. In the profile, the edge of Subfeature 1 is identified as a shallow pit cut into the saprolite beneath a construction fill matrix (L. VI).

Subfeature 1, and probably the other prepared surfaces, was constructed on this occupational surface. In the BAC photographs, the subfeatures are rectangles of sediment edged in coral cobbles. They may have been slightly elevated above the occupational surface. The rectangles appear to be about a meter wide by several meters long with an azimuth parallel to the step-terrace or roughly east-west. At least in the case of Subfeature 1, the surface of the rectangle was intentionally covered with a layer of broken pottery sherds that served as a foundation for whole pots.

¹⁵ Data concerning the prepared surfaces is not available due to the death of Rita Olsudong, BAC Senior Archaeologist, who conducted the initial investigations. The BAC photo shows three prepared surfaces but there may have been more that were not identified during the intensive construction activities. It is probable traditional vessels were placed on these subfeatures.

Clay deposits (Ls. III, IV) cap the central area of Layer V, on Subfeature 1. Above this is an enormous amount of construction fill (Ls. I, II) that elevated the terrace by between 3.2 and 3.8 m. The fill material is redeposited saprolite that retains much of its integrity. It likely originated from earth removed during the formation of the adjacent ditch, ridge or gully. The construction fill is capped by a thin A horizon under a more recent humic mat.

Two samples of charred wood collected in the intact cultural deposit (L. V) were submitted for radiometric dating (Table 18). The wood was identified as *Intsia bijuga* (*dort*), a highly valued construction material whose leaves are used as fertilizer to provide nitrogen to the soil. The samples yielded almost identical date ranges with WK-29178 measuring 2000–1860 (93.1%), 1850–1830 BP (2.3%) calBP and WK-29179 measuring 1990–1820 calBP.

Whole Pots

Subfeature 1 supported three whole pots placed upright and intact on a bed of stacked, unarticulated pottery sherds (Figure 67). BAC reassembled two of the three pots recovered on Subfeature 1 for display in the Belau National Museum. Vessel analysis was conducted on these reconstructions. Neither of the vessel forms are documented in Palauan pottery assemblages, and the form of Pot 1 is rarely, if ever, encountered in the Pacific islands (C. Sand, pers. communication, 2009).

Pot 1 is a round bowl with a 24 cm in diameter orifice, a 30 cm in diameter body and a depth of 24 cm (Figure 68). Body thickness varies from 6.2 to 10.5 mm and rim thickness is 10.2 mm. The unrestricted vessel displays fine grog temper fired in a reduced atmosphere and a straight-sided rim with a flat lip. The light brown slip adhering to the pot's interior and exterior surface is wearing off to reveal the black (reduced) body below. A few smoke clouds are on the pot's base.

The upper third of Pot 1 is ringed with horizontal and vertical bands measuring ca. 6 mm thick and 1.3 cm wide that were attached as a unit after the vessel's base was formed. The two horizontal bands, one 2.4 cm and the other 4.8 cm below the lip, are connected by five vertical

strips. Between the horizontal bands, the pot's body bulges inward about 5 mm. Each 1.2–1.5 long vertical band extends from the vessel's lip to 1.3 cm below the lower horizontal strip. The distance between each vertical band is between 1.3 and 1.5 cm.

Pot 2 is a round restricted bowl with an orifice diameter of 16.0 cm, a body diameter of 32.5 cm at 8.0 cm below the lip, and a depth of 20.0 cm (Figure 68). The vessel has an exterior thickened rim that measures 13.2 mm thick and was fired in a reduced atmosphere. The body is 8.7 to 12.0 mm thick. Light brown slip was applied to the interior and exterior surfaces.

5.6.4 Discussion and Sequence of Events

Because of the narrow strip of sandy beach, Melekeok's coastline was probably occupied very early in Palau's cultural sequence. The small beach would not have supported many inhabitants and structures may have been elevated above the shallow lagoon or built on the slopes of the backing low hills. At the time, these hills likely rose directly from the sandy plain. The extent of the fertile wetlands currently fronting the slopes probably developed later in the erosional sediments generated from land clearing and earthwork construction. This naturally and culturally changing landform covered and mixed traces of early human occupation along the coastal strip.

The ridge under investigation may have been levelled to accommodate structures before the activities represented in the profile. The first identifiable cultural activity in the Subfeature 1 terrace is removal of the A and B horizons and cutting and shaping the saprolite to support the Layer V living surface. As B horizons in Babeldaob's heavily weathered volcanic soils are generally at least several meters thick, a huge amount of soil would have been removed. If the inhabitants only wanted a level surface, than it was not necessary to expend the effort required to remove this much soil. Stripping the entire thick B horizon strongly suggests a large-scale construction event. The design likely called for lowering and levelling the terrain where the Subfeature 1 step-terrace is to generate the resultant substantial quantity of sediments for shaping and elevating a nearby area, perhaps the adjacent hilltop crown.

The thick intact cultural deposit (L. V) shows intensive or long-term use of the terrace. In part, Layer V could be the remnants of the pre-construction A horizon if, during the initial construction phase, the A horizon was stripped off and set aside in preparation for its placement on top of the final cut surface. This construction technique was probably very common in the Earthwork Era. Due to the depth of material removed, the extent of earthwork formation during this construction phase and the planned use of this part of the structure (i.e., not for cultivation) it is unlikely that the saved A horizon was replaced on this cut surface.

Subfeature 1 and the other prepared surfaces were constructed on or in this living surface. Post moulds and burned wood identified as *dort*, one of Babeldaob's strongest building materials, suggest the Layer V occupational surface supported structures. It can not be determined whether these prepared surfaces were built: 1) over a lengthy period of occupation on a terrace dedicated to the associated event or 2) during a single set of contemporary actions after an occupational period.

Regardless of the temporal range of their construction, the prepared surfaces were of such importance that they were intentionally buried with a thick layer of clay (Ls. III, IV). The clay may have been placed for a combination of protection and symbolic identification of what the prepared surfaces meant or contained. This type of deposition resembles a clay cap placed on human burial pits in Ngaraard's Rois terrace (Tuggle 2007:343–348). Tuggle (2007:368) identifies the deposition of the clay, dated to ca. 1700 calBP, as likely representative of a ceremonial closing of the burial area.

The lack of evidence for the subsequent development of an A horizon on this clay surface suggests the fairly rapid deposition of the immense amount of construction fill directly onto the clay. This fill created a new occupational surface that is several meters lower than the summit of the crown and substantially deepened the adjacent ditch feature. It is possible the ditch was created in conjunction with the elevation of the step-terrace. The material removed during ditch excavation was used as fill to raise the step-terrace by about 3.5 m.

The combination of unique whole ceramic vessels on a carefully prepared surface intentionally covered by an impermeable clay layer identifies a significant ritual or ceremonial event, perhaps burial markers of elite individuals. Any evidence of human remains that might have survived in the acidic soils was removed during the recent bulldozing. The west edge of the shallow depression identified in the profile could be the remnant of a burial pit that was directly underneath the prepared surface with the whole pots. However the length of the rectangle does not appear to be long enough to hold an adult interment, if laid in an extended position. The prepared surfaces could also be altars to support offerings that were created specifically for the ensuing construction or the cultural event instigating the construction.

The deeply buried living surface containing the prepared surfaces is radiometrically dated to roughly 2000–1820 calBP (WK-29178, -29179). This date gives a *terminus ante quem* for the first large-scale construction phase that removed the B horizon and a *terminus post quem* for the second large-scale construction phase that deposited over 3 m of fill material onto an occupational surface containing ritual features. It is possible that both phases of construction and the living surface sandwiched between the two occurred over a relatively rapid period of time spanning a few centuries. Or the entire sequence of events could represent a single connected activity that transpired over a short intensive construction event at the Roismelech complex.

If the latter scenario is the case, then Layer V may represent the A horizon that was removed and stored before the first construction phase that eliminated the B horizon and cut and levelled the C horizon. The stored A horizon could then have been spread across the newly exposed C horizon followed by the creation of the prepared surfaces and deposition of clay then construction fill. This sequence of events seems unlikely, as the prepared surfaces could have been constructed directly into the exposed C horizon without going through the extra effort required to place the stored A horizon.

As Roismelech's only ^{14}C assays, the two dates can only be used to discuss the events identified in the profile. However, the quantity of earth removed in the first construction phase

and deposited in the second phase is of such magnitude to suggest that the central core of Roisemelech was being shaped at this time. A large-scale construction event would demand engineering skill and a carefully planned architectural design to ensure the cut and fill equalled out and that the earth structures stayed upright and did not slump. Furthermore, the location of the cut and fill exposed here—adjacent to the crown and deep ditch on the west and gully on the south, supports the idea that the material removed and replaced came from nearby earthwork components.

In the larger context of the Melekeok earthwork district, the assays show Roisemelech was occupied simultaneously with the nearby inland Ngerulmud (Liston et al. 1998) and Engoll (Kaschko 2007) crown complexes. All three structures were occupied by at least 2000 years ago.

5.7 Summary

During the course of thesis investigations 31 new archaeological sites were formally identified and recorded and seven of Babeldaob's earthwork sites were first documented with the excavation of 49 stratigraphic trenches and facing a large wall profile. Of the 48 samples of carbonized plant material submitted for taxonomic identification, 33 were chosen for radiocarbon dating and produced valid radiometric assays. The 15 soil samples that underwent chemical and physical characterization studies confirmed the presence of highly acidic soils that do not contain identifiable evidence of human occupation or amendments. Only four of the ten soil samples scanned for archaeobotanical remains produced preliminary evidence for pollen profiles. Seven reconstructable vessels in earthwork contexts were retrieved during the course of fieldwork.

Significant contributions from this fieldwork include the first archaeological identification and description of basins on crown summits; the first certain evidence of crown interments; and the first identification of a complex water control system accompanying earthwork structures. Four of the seven reconstructable vessels are unique forms never before identified in Palau, with two of these displaying highly unusual annular bases.

The large quantity of archaeological radiometric determinations from earthwork sites assured a significant input into the development of an Earthwork Era cultural sequence model. Discussed in Chapter 7, these assays included the two earliest archaeological dates associated with cultural features collected in earthwork deposits. The ^{14}C assays allowed for identification of the period of crown basin use and abandonment and human interments on crowns. These field and laboratory results are integrated into recent investigations to analyse and interpret the development of Babeldaob's earthworks as contributing to and identifying differing leadership modes in the remainder of the thesis.

The development of monumental structures is significant to understanding the relationship between earthworks and the evolution of sociopolitical complexity. The complex stratigraphy revealed in the excavations provided substantial input into the creation of a long-term earthwork construction sequence. Identifying the construction challenges, building techniques and the quantity of fill and in situ material is useful in detecting the original constructed size of the earthwork and their changes through time. This is used to determine at what stage monumentality was achieved and how deliberate it was to attain monumentality. This data is also useful in estimating the labour, materials, skill and managerial effort needed to build each structure. Issues concerning labour investment and management are directly relevant to sociopolitical organization. The following chapter explores these topics by examining Babeldaob's earthworks as an engineered landscape.

6.0 AN ENGINEERED LANDSCAPE

Huge expanses of Babeldaob's earthworks retain their integrity despite centuries of natural degradation processes. Considering Palau's harsh environment and the antiquity of the structures, preservation of earth structures is a testament to the skill and ability of their creators. Stratigraphic profiles reveal the complex cut and fill techniques used to build enormous earthworks in Babeldaob's weathered soils.

The extent of Babeldaob's modified landscape suggests a large labour force under managerial control and organization. Quantitative estimates of labour inputs are a means of exploring scale of social organization and extent of both labour control and surplus material resources. Use of volumetrics or architectural energetics (Abrams 1989; Abrams and Boland 1994; Lacquement 2009) to estimate energy investments entails understanding the engineering techniques and methods used in construction. This is largely dependent on the characteristics of the available construction materials. This information is also useful in discerning stages of structural expansion that may be temporally associated with societal development and the nature and scope of environmental impacts resulting from construction efforts.

6.1 Construction Challenges and Techniques

Building aesthetically pleasing structures capable of particular functions was not the single objective of Palau's landscape engineers. The underlying concern would be with structural durability and performance within the parameters of Babeldaob's geomorphologic and climatic conditions. Engineers would strive to identify potential construction hazards and implement preventative measures. The complex stratigraphy in stratigraphic profiles reveals a significant concern with the selection, mixing and positioning of building materials. Soil fill was not randomly chosen or placed unsystematically but demanded engineering principles and sophisticated construction techniques.

These heavily weathered volcanic soils are particularly vulnerable to mass wasting. Slips and slumping occurs when a slope's gravitational forces exceed its resisting forces. Gravity is

affected by gradient, material and groundwater while the primary resisting force is the material's shear strength, defined by its cohesion and internal friction. The relatively high shear strength of Palau's moist clayey soils is substantially decreased by long periods of heavy downpours that saturate the oxisols and decrease the friction between the platy particles. Slope stability on Babeldaob is complex and unpredictable due to the intricate heterogeneity of the saprolite's internal structures (e.g., relict joints and veins, remnant boulders¹⁶) that control the mechanisms and locations of slope failure (Aydin 2006:89).

In Palau's wet tropical environment with volcanic soils so susceptible to erosion and mass wasting, water management and large-scale erosion control measures are essential to combat soil degradation, drain crops and protect marine resources and fresh water supplies from sedimentation. Erosion control is needed during building events and as a component of the built structure for its daily use. As observed during the recent Compact Road construction, even with extensive modern erosion control measures in place tremendous amounts of sediments wash downslope during earthmoving.

Given Palau's edaphic conditions and high precipitation, slope stabilization measures likely included reducing loads through slope gradients, controlling groundwater and removing soil discontinuities. Years of trial and error went into identifying and implementing these measures to perfect earthwork construction so that structural elements would not fail and component parts could become more massive or elaborate.

Earthwork construction was probably scheduled to encompass the six-month dry season to avoid design problems, mass wastage and moving heavy saturated clays. Wet clays are heavier and more difficult to work with while exposed sediments are easily eroded during heavy rains. Due to the high precipitation even in the dry season, the largest labour force possible would be mobilized for a building event in an attempt to reduce the construction period.

¹⁶ The rounded basalt boulders exposed in the saprolite during earthmoving were likely used in construction of stone pavings, facings and buttresses.

6.1.1 Slope Gradient

Generally, reducing the slope gradient lessens the risk of landslides; however, in Palau's clayey soils, the most effective construction angle to prevent cut-slope failure is close to 90° (A. Morrison, pers. communication, 2005). The efficacy of using vertical slopes is seen in the still upright sidewalls of ancient earthworks and Babeldaob's bulldozed dirt roads. In vertical slopes, the potential for mass wasting increases with the height of the vertical cut due to load overburden and the likelihood of encountering inhomogeneous material.

Construction of a rock or earth buttress, berm or wall at the toe of a steep slope or on a terrace riser can inhibit slope failure. Stone facings on crowns could also prevent mass wasting by keeping the structure from drying out and cracking open. However, due to the cohesiveness of Palau's soils, stone facings add little to lateral stability and may have never been a substantial element of earth structures.

Step-terrace stone facings are rare and currently only identified on the upper tier of Ngaraard's Roisingang and Melekeok's Roismelech complexes. Remnant cobble facings are embedded in a few crowns, notably Ngerbecharerong in Ngaraard. The buried cobble columns close to the edge of at least two high terrace risers in the Ngedesaker complex could be buttresses. Although perhaps never common, this stonework may be only a sample of earthwork facings that have since eroded or whose stone building material was removed for use elsewhere. The extent of stone or earth buttresses or facings as a design feature is uncertain.

The few stone facings currently found on crowns and larger earthwork components may have primarily served as symbolic embellishments with a sociopolitical or ceremonial purpose and only secondarily functioned as an engineering element.

6.1.2 Controlling Groundwater

Controlling groundwater to reduce infiltration and erosion and direct water away from a potentially unstable mass is a significant factor in slope stability. Landscapes designed with

gullies, ditches, drains and sloped surfaces help contain runoff and direct water flow for both engineering and functional purposes. Interceptor ditches installed at the slope's crest and toe and the back of terrace treads would direct runoff into the wide gullies descending the complexes. The subtle slant in some step-terrace systems, such as Ngeskebei (Figure 12 and Figure 32), uses gravity flow to direct drainage. Many of Palau's ditches probably served simultaneous purposes as both defensive features and to direct surface flow away from structurally weaker elements and inhabited areas and onto cultivated plots needing water.

Vegetative cover on earthwork slopes serves multiple purposes. In addition to absorbing water to moderate infiltration, vegetation binds the soil together to promote structural stability by discouraging desiccation and erosion. Surfaces exposed both during and after construction were likely quickly covered by a combination of newly planted vegetation, saved A horizons and mulch.

Effective drainageways are impervious to erosion and clear of blockage. Stripping the unstable soils down to the more cohesive saprolitic material furnished construction material and protected drains from erosion. Stone or vegetation lining the base and sides of some gullies and ditches protects the soils beneath from runoff. Stonework in anthropogenic gullies also stabilizes sediments in the bordering constructed features to prevent undercutting during periodic deluges (Liston 2008). Gullies bounding natural formations did not require stabilizing measures since the intact soils are in a state of relative equilibrium.

Compacting construction fill reduces the adverse effect of groundwater by decreasing pore space and increasing material density. As loosely packed terrace construction material is rarely encountered in archaeological investigations, earthwork fill was probably compacted to ensure a solid foundation.

6.1.3 Soil Discontinuities

Earthwork engineers attempted to overcome the unpredictable imperfections in the soil column and create a stable core. Variations in terrace construction techniques may relate to the

historic progression of building methods related to soil discontinuities. Structural remodelling or differing techniques associated with specific engineers or districts could have also played a part.

At first, building earth structures may have been a process of simply levelling hills and ridges and cutting Babeldaob's dense clays into steps with heavy wooden digging sticks (*ongereuakl*). The excess sediments derived from these activities were transported by woven baskets to expand or elevate other structures. Initially, baskets of fill material were unsystematically placed on the existing surface. A hillslope step-terrace in Ngiwal was constructed by adding 20 layers of haphazardly dumped baskets of sediment capped by three bands of construction fill onto the in situ A and B horizons (Liston 2011b:519–523).

Due to the heterogeneity of the underlying saprolite many of these initial building efforts probably resulted in massive cut-slope failures while other structures remain standing to this day. In time, engineers learned that removing naturally occurring defects and applying homogenous and laminated layers of sediment toughens the internal structure to increase stability and prevent mass wasting. Once earthwork construction became firmly established, structural soil columns consist of stratified contrasting bands of construction fill resting on a levelled C horizon.

The scenario of this latter earthwork construction sequence may began with stripping off the thin fertile A horizon and preserving it for use elsewhere. This was followed by the laborious task of removing the perhaps several meter thick B horizon and partial removal and levelling of the C horizon. It is not necessary to expend this much effort in removing so much soil if the only objective is a level surface. However, removal of the B and upper C horizons eliminates some of the natural soil imperfections and allows for placement of stable base layers. At the same time it produces construction fill and levels or shapes the foundation.

Sometimes this levelled C horizon marked the end of the construction event and became the occupational surface; more often, the foundation was capped by a series of evenly spread, redeposited C horizons, sometimes mixed with B horizon soils. Despite the potential mixing of

individual bands, the lenticular fill deposits remain homogenous and often do not overlap, intrude upon or interbed with adjacent bands. The stored A horizon was sometimes placed onto the final constructed surface. In this manner immense quantities of construction fill raised and levelled the terrain.

A step-terrace attached to a modified ridge in Ngiwal displays 3.0 m of construction material with seven laminated fill deposits ranging from ca. 0.1 to 1.7 m thick (Liston 2011b:424). Three 0.6 to 2.0 m thick layers of construction fill raise the Ngemeduu crown by 4.2 m (Phear 2007). These lenticular fills were probably not a concerted effort to use Babeldaob's highly colourful saprolite to produce aesthetically pleasing patterns of colour although in some instances deposits of yellow clay cap significant events, such as human burials (Rois) and whole vessels (Roismelech).

In some instances cut-slope failures were probably intentionally produced as an effective and less arduous method for generating large quantities of loose fill material and removing huge quantities of soil. These mass-wasting events would be carefully planned and engineered in order to contribute to the overall design of the structure and to produce the accurate quantity of soil needed for construction material. Although some gullies are naturally occurring others are the planned results of these deliberate massive slope failures.

Similarly, earthwork engineers likely employed erosion control measures to direct the flow of sediments away from fresh water sources, habitations, horticultural fields and other occupied zones and onto areas requiring construction fill or towards unused terrain. This level of engineering expertise could explain the lack of thick erosional deposits displayed in some paleocores and excavation units despite their proximity to earthwork complexes.

6.1.4 Construction Phases

Observing that lower terraces are random and irregular in appearance while those on hilltops display a more consistent pattern, Osborne (1966:96, 154) proposed that Babeldaob's terraces were not planned but occurred over a period of centuries in a "slow process of

levelling rather than one of short-term construction.” It is proposed here that the complex engineering required for stable and sustainable structures and the integration of component parts suggests that earthwork complexes were designed as a unit soon after their inception. Stratigraphic profiles indicate building the main bulk of many earthworks occurred in single or double construction episodes that may have extended over several dry seasons.

Two-phase construction is evident at Roismelech although the time span between building events is not identified. The first phase involved stripping of the thin A and thick B horizon and a levelling the underlying saprolite. The saved A horizon may have been placed back on the surface of the cut C horizon to serve as the occupational surface. The second phase is identified by a partial cap of a band of yellow clay and deposition of a 3.8 m thick homogeneous saprolite fill onto the occupational surface. The occupational surface of the remodelled structure appears to have accumulated through time rather than through the intentional placement of a reserved A horizon.

Rebuilding of some terraces, such as earlier unstable structures, may not be stratigraphically recognizable due to stripping off previous fill and occupational matrices to reach the desired C horizon foundation. As at Ked era Aranguong, fairly minor vertical remodelling events are sometimes superimposed over parts of the structure leaving the former occupational surface, fill sequences and saprolite foundation in situ. This suggests that the previously constructed foundation was recognized as adequately stable.

It appears that in many instances structures were not vertically enlarged over time, either by design or through inadvertent accrual. Some complexes likely expanded horizontally as particular activity areas grew. However, based on 11 radiocarbon dates and stratigraphic interpretation of the complex depositional sequence, Tuggle (2007:195–197) identified the deliberate construction of a progressively higher crown in north Ngaraard.¹⁷ The stratigraphy

¹⁷ This long-term rebuilding may be associated with the location of the Isakos crown outside of the large Ngaraard earthwork district.

displays three construction episodes each 300 to 400 years apart and separated by occupational periods and possibly a hiatus in crown use.

Embellishments such as knobs, berms and ditches were commonly added to previously existing structures and basins were infilled. These and other modifications are likely associated with a significant historical event, a functional change, re-occupation or a renovation.

6.1.5 Discussion

The long-term historical development of earthwork sites does not appear to be one of intentional or accidental expansion of structures during multiple construction episodes, although there are some examples of this occurring. Rather it seems likely that massive structures were built in single construction episodes perhaps on a previously levelled surface. It is possible that the majority of earthwork construction took place over several centuries after which energy was devoted to upkeep and remodelling or adding embellishments. Substantial archaeological excavation is needed to test this developmental model.

On Babeldaob, small individual structures (e.g., step-terraces) can be built with little effort. However, it is unlikely that larger components (e.g., crowns) and complexes of step-terraces and other earth features were built through accretion of structural elements. The overall unity of the design with the integration of components such as gullies extending down the entire complex suggests a coordinated building effort. Furthermore, the erosional impact to structures below by construction higher in the complex would discourage piecemeal building. It is more efficient and productive to build the entire foundational structure in a single large-scale event. Through time, components may have been modified or the complex may have been extended.

6.2 Investment of Labour

Experimental and ethnographical studies demonstrate that not all construction efforts require a significant logistical, economic or social investment (e.g., Webster and Kirker 1995; Muller 1997; Hammerstedt 2005; Smailes 2011). Furthermore, in seven societies transitioning

to larger social formations, Peterson and Drennan (2011) found the per capita investment for large-scale public works to be negligible, varying from an annual per person investment of a few hours up to a week. This tax rate is dependent on population size with smaller societies containing less able-bodied workers imposing the highest rates. If large-scale public works and monumental structures do not demand such a significant investment by a ruling body, then they could be built at a kin-based or village cooperative level (Kolb 1997; Erickson 1993, 2006).

Construction and maintenance of Babeldaob's earthworks is labour intensive. This is due to the density of the excavated material, removal of the underlying in situ horizons to ensure a stable foundation, transportation of material on steep inclines and compaction of newly deposited sediments. Furthermore extensive erosion control measures must be implemented during the building process.

Constructed with cut and fill techniques, rather than from the ground up, it is difficult to estimate the effort used in building the complexes through quantification methods such as volumetrics or architectural energetics (Abrams 1989; Lacquement 2009). The massive size of the structures requires extensive excavation to identify the horizontal and vertical extent of construction fill and the number of construction phases. It is often impossible to determine the amount of in situ material removed. Calculations of the labour invested in individual components, such as a crown, may be more manageable.

Archaeological approximations of the per capita investment for construction of earth structures worldwide vary wildly with estimates ranging from about 1.0 to 3.0 m³ of soil moved per person in a six to seven-hour workday (Erasmus 1965; Muller 1997; Bernardini 2004; Hammerstedt 2005; Erickson 2010). These calculations are not directly comparable to Babeldaob's labour requirements due to differences in climatic and edaphic conditions, construction techniques and other variables. They do provide a starting point for examining the potential energy expended by the Palauan workforce. The movement of 1.0 and 1.5 m³ per

person per day figures are used as, based on experience, excavating, transporting and compacting even this much of Babeldaob's soils in a six-hour day is a generous allotment.

Phear's (2007:56–58) excavations in the summit of the Ngemeduu complex suggest that at least 2,500 m³ of fill was used to raise the hill surface by about 4.2 m. If 1.0 m³ of soil was moved per person in a six-hour workday, placing this much fill on Ngemeduu's already levelled foundation would take about 30 days of work for 83 people. Increasing the quantity of soil to 1.5 m³ per person per day lowers the workforce to 55 over a 30-day period. This figure does not include the labour hours needed for removal of the B and part of the C horizon to prepare the foundation. Perhaps an equal number of labour hours were dedicated to erosion control measures during the building process. What proportion of the available labour force this represents is unknown as there are no estimates of Palau's ancient population.

This labour estimate suggests that during Palau's six month dry season multiple structural elements could be built. It is conceivable that entire complexes could be constructed over consecutive dry seasons with a substantial labour force. What must be taken into account is that perhaps an even more significant investment of labour was devoted to monitoring and maintaining the earth structures so that they performed their intended function without degrading the environment. Further, as discussed in Chapter 8, as the step-terraces were likely being cultivated, an enormous input of energy was needed to retain soil fertility. While part of the labour force was constructing structures, an equal or larger number was likely dedicated to year-round maintenance, erosion control and agricultural tasks.

In addition to the long-term input of labour, earthwork construction and use requires a thorough knowledge of soil mechanics, hydrogeological conditions and engineering principles. Incorporation of water and erosion control strategies while minimizing construction disasters demands carefully planned architectural designs with sophisticated construction techniques. Those with advanced technological knowledge, engineering expertise and extensive organizational capabilities were likely responsible for designing and directing the building and maintenance of Babeldaob's earthworks.

6.3 Labour Management

On Babeldaob, a continuous substantial expenditure of energy was devoted to building and maintaining earth structures, preventing environmental degradation and ensuring long-term productivity of dryland cultivation systems. The mobilization and management of labour to conduct these activities is a significant factor in transforming sociopolitical organization (Sahlins 1958; Brookfield 1972; Scarborough 2003). Obtaining and administering the labour for construction of intensive agricultural production systems, and monuments, is presented as coming from the 'bottom-up' or the 'top-down' (Erickson 1993, 2006; Fisher et al. 1999; Janusek and Kolata 2004). In the bottom-up perspective, intensive systems are the work of local kin-based groups and are decentralized. Following Wittfogel's (1957) 'hydraulic hypothesis,' in the top-down perspective, the organization and management of engineered landscapes or agricultural productivity is attributed to centralized elite management.

Since Wittfogel's work, complex irrigated systems are shown to evolve and be maintained without the oversight of a centralized authority (Earle 1978; Lansing 1991). Households and kin-groups are known to self-organize and provide the labour for intensive cultivation systems (Erickson 1993; Netting 1993; Kolb 1994) while monumental construction by local communities without strict hierarchical control is identified in Peru (Shady Solís et al. 2001; Vega-Centeno 2010). Erickson (2006) argues that the labour for cultivated field systems, roads and other public works is significantly greater than that invested in creating a monumental structure. Although these systems often grow through accretion (Doolittle 1984; Erickson 2006), the created cultural landscape is a product of community effort rather than elite coercion. Despite the community potentially acting in response to external pressures, and perhaps changing previously used work tactics, the creation and management of production systems lay within the domestic sphere (Erickson 1993, 2006; Denevan 2000).

The long-term dynamics of production, labour and social organization are both a catalyst and a component of changing sociopolitical structures (Janusek and Kolata 2004). The top-down and bottom-up approaches to construction fall along a complex continuum of changing

social relations. Communities may have initially organized the development of agrarian systems while advantages, such as coordinated administration, that led to increased productivity could have resulted in more centralized political economic strategies. The shift in management through time from individuals to chiefs identified in Hawaiian dryland field systems is attributed to alleviation of risk and improved efficiency (Ladefoged and Graves 2000; Allen 2004). Different types of labour organization may have been in place dependant on the situation, with bottom-up approaches used in the community and top-down approaches at the district level.

On Babeldaob, the initially small structural elements, such as individual step-terraces, may have been built at the household level. The complex engineering techniques, the overall integration of the design and the negative impacts of erosion on the natural and cultural landscape below the worksite suggest that earthwork complexes were designed and built as a unit. A pooled labour force, perhaps a kin-based group assisted by neighbouring communities, could build a complex as a coordinated effort over single or successive dry seasons. Earthwork design was likely undertaken by an engineer with the specialized knowledge needed to erect a stable structure in Babeldaob's particular environmental conditions.

The large number of workers to be fed and housed, the complexity of the design construction techniques and the need for erosion control measures, required coordination and management of the gathering, the building process and the surplus staple resources. Once construction necessitated a coalition of several communities, it is likely organization and management of labour transformed to more of a top-down system although perhaps retaining corporate strategies such as council leadership. The surplus needed to host the visiting communities suggests a leader financing the building event.

Over time, once construction became firmly embedded under elite management, labour may have become a form of tribute. Whether this put a serious burden on the local workforce can not be identified without demographic studies. In Peterson and Drennan's (2011) scenario, Palau, with a comparatively low population, would have a 'high' tax rate of at least a week per

labourer. Although this tax rate may be somewhat accurate for the time allotted to district level tribute, far more energy is needed at the community and household level to keep the already constructed structures maintained and operating as cultivation features.

6.4 Social Aspects of Construction

Alliance for a common goal promotes collective thought and cohesion to enhance social solidarity. The negligible evidence of activity on some Hopewell earthworks led Bernardini (2004:350) to suggest that by drawing upon labourers outside of the local community the most significant event in the life history of the Hopewell monuments was the act of their creation. This communal act of monumental construction became the principal dynamic in the process with the ultimate practical function of the structure only a secondary goal (Pauketat 2000; Pauketat and Alt 2005:228; Joyce 2004; Kolb 2011). In Palau, the group construction process is a significant factor in building earth architecture but is not the ultimate objective. Once constructed, earthworks had multiple practical and symbolic functions.

Events such as feasting and ritual that accompany large-scale construction events contribute to re-enforcing ideology, generating cohesion and legitimizing elite status. A ritual aspect to building Babeldaob's earth structures is indicated by the structured groups of whole pots and pot caches found underneath and in construction fill (see Chapter 9). Participation in the ritual event followed by the construction process not only enforces social inclusiveness but also memorializes in physical form the shared experience (Tilley 1994; Pauketat and Alt 2005:217). According to Phear (2007:138–139), in Palau “the process of construction and ritual not only brought people together and created a sense of attachment and history to the land, but also created monuments serving to reinforce memory and create tradition.”

Feasting is a leadership strategy used by elites to obtain labour for public works and as propaganda and manipulation to attract and consolidate a faction of supporters (Hayden 1996; Dietler and Hayden 2010). After the feast, the host community, or its leader, might then finance the remaining construction related meals and other resources, which on Babeldaob could be considerable given the time needed to build such large structures. Almost all of the

wide range of mechanisms and benefits of feasting listed by Hayden and Villeneuve (2011:441) contain “some element of solidarity creation among participants” and “result in enhanced prestige for the hosts.”

On Babeldaub, feasting behaviour has not been detected in earthwork deposits; although, given the acidity of the soils, little evidence beyond perhaps pottery vessels used in the activity would remain. Ultimately, feasting and ritual in relationship to earthwork construction worked on multiple levels to support the elite and commoner by providing a combination of practical, social and political benefits (Kolb 1994; Earle 1997; Hayden and Villeneuve 2011).

The entire process of building earthworks with incorporated ritual and feasting was a source of social power that helped create and reinforce the dominant ideology (Kolb 1994). The political economy is a strong component of the process by the need for surplus for these events and the projected use of the earth structures. According to DeMarrais et al. (1996:6–7),

The tremendous costs of hosting ceremonial feasts, constructing monuments or manufacturing the paraphernalia and costumes for events ground ideology in the economy. If ideology is seen as representation, ceremony, and material culture, we can understand how control over the economy and the labour force directly extends to control over ideology. An ideology rooted in a material medium can be controlled in much the same way that the manufacture of other utilitarian and wealth goods is owned, restricted and transferred through the institutions of political economy.

Uniting several communities around feasting and monumental construction has the potential to introduce conflict into the system as each community competes for supremacy (see Chapter 10). By posturing for prestige, each community would attempt to surpass the other with more lavish feasts, grandeur ritual performances and larger more complex earth structures to gain sociopolitical advantage. Ultimately, the surplus and labour investment and the attachment of social meaning and tradition to an earthwork complex during the construction process transform the built landscape into a valuable commodity.

6.6 Summary

The organization of Babeldaub's earthwork construction is not well understood. The proposed model for earthwork construction is based on an understanding of the physical

properties of the island's soils and interpretation of earthwork stratigraphic profiles. This strongly indicates that a thorough knowledge of soil mechanics, hydrogeological conditions and engineering principles is needed to build even small structures in the erosion prone silty clays. Until these sophisticated construction techniques were achieved, variation in structural size or morphology was likely not an option.

The construction and maintenance of step-terraces and other large earthwork complexes could have occurred from the bottom-up, at the community level. Integration of numerous communities ensured enough labourers. This would alleviate the protracted production of building, lessen the burden, allow for some members of the community to continue other labour demanding tasks and offers an opportunity for strengthening and negotiating social relationships. Construction and associated ritual and feasting events could be financed and organized by a council of community leaders. The community receiving the assistance would reciprocate by helping construct neighbouring earth complexes in the future. Eventually labour may have become a form of tribute.

These communal construction activities would support a strongly integrated community with a sense of collective identity, promote emerging leaders and reinforce the dominant ideology. The process would simultaneously encourage competition between participating groups and in due course transform the built landscape into a valuable commodity.

Understanding soil mechanics and construction sequences is helpful in stratigraphic interpretations of earthwork deposits. This is significant as a principal objective of the archaeological excavations was to obtain radiocarbon dating samples from secure and meaningful contexts. Identification of these meaningful contexts requires careful stratigraphic interpretation to ensure that the correct source of the sample to be dated is recognized. These assays provide a chronological framework for cultural sequencing to address the complex research problems related to the development of monumental architecture and its link to political evolution. The following chapter presents an earthwork chronology to monitor the

transformations in the expressions of power and authority in Babeldaob's earthwork landscape.

7.0 EARTHWORK CHRONOLOGY

Only after establishing the temporal framework of earthwork construction, use and abandonment can a model of Babeldaob's Earthwork Era sociopolitical development be constructed. This chapter discusses the difficulties inherent to establishing an earthwork chronology on Babeldaob, provides the suite of terrace radiometric determinations focusing on assays collected during the course of these investigations and presents the chronological framework for the use-life of Palau's earthworks.

With a limited amount of inland archaeological data, Palau's early cultural sequences integrated earthwork structures into largely speculative relative chronologies (Osborne 1966; Lucking 1984; Masse et al. 1984; Morgan 1988; Hijikata 1993). Recent archaeological and paleoenvironmental work (Athens and Ward 2002, 2005; Liston 2007a, 2008, 2011a; Phear 2007; Wickler et al. 2007; Tuggle 2011; Athens and Stevenson 2011) have produced data sufficient to overcome the problems inherent in constructing chronologies in heavily reworked landscapes.

Palau's recent cultural sequence models are largely defined by changing settlement patterns that are directly related to the nature of the agricultural base and to natural and anthropogenic transformations in the landscape (Clark 2005; Masse et al. 2006; Liston 2007a, 2009, 2011a; Clark and Reepmeyer 2012). After Compact Road archaeological investigations, with the expanded corpus of Babeldaob's radiocarbon assays, Liston (2007a) constructed a Palauan cultural sequence by superimposing the chronologically organized archaeological sites onto the temporal framework offered by paleoenvironmental investigations. This sequence clearly tied the oscillating pattern of savannah/forest formation identified by Athens and Ward (2002, 2005) with the use-life of the interior earthworks. By incorporating the substantial quantity of data accrued during the final phase of Compact Road work and other more recent excavations, Liston (2009, 2011a:485–502) proposed a chronological model for the rise, use and fall of earthwork districts. Inserting the additional 33 assays collected during these

investigations into this sequence both tests and refines the chronology of earthwork development.

7.1 Chronological Methods and Difficulties

In addition to using radiometric determinations, temporal development of earthworks can be examined with paleoenvironmental data, sequencing of material remains or architectural types, traditional histories and ethnohistoric literature. Paleoenvironmental evidence reveals broad landscape alterations from both a geomorphological and a botanical perspective. These landscape transformations serve as “proxy indicators of human impacts on the environment” (Dickinson and Athens 2007:191) to provide an independent check for archaeological interpretations. Babeldaob’s paleoenvironmental data is used as a component in the chronology to track alterations in the natural landscape potentially due to earthwork construction and use.

Traditional pottery attributes can assign temporal parameters to earthwork strata by providing relative diagnostic markers much like ^{14}C assays in the same contexts. Due to a lack of securely dated, particularly older, contexts and relatively few conspicuous temporal changes in stylistic attributes, a Palauan pottery chronology is just now being formulated (Clark 2005; Desilets et al. 2007; Liston 2009; Liston et al. 2011). As many of the same attributes are found throughout the pottery sequence, relative dating depends on the characterization of large ceramic assemblages to identify the predominant attributes.

It is too early in the process of Palau’s earthwork investigations to securely correlate changes in terrace morphology with specific units of time hence structural form can not be used in relative dating. Cautious interpretation of oral traditions has the potential to elucidate general timelines and a relative chronology. However, Palau’s oral histories and ethnographic accounts provide very little information about the terraced hills (Liston and Miko 2011). With few independent means to develop an earthwork chronology, accurate radiometric dating is essential to establishing a cultural sequence for Babeldaob’s terrace construction and use.

Using absolute dating methods to establish an earthwork chronology is difficult because of the complicated depositional histories resulting from cut and fill construction, periodic intense erosional events and repairs or additions obscuring and destroying earlier structures (Liston 2005:303). This is compounded by the sheer size of the earthworks and their multifunctional and functionally evolving components requiring extensive investigation of each complex.

Not applicable to Palauan earthwork assays is the almost universal protocol of sample credibility only if originating in a primary cultural deposit or discrete archaeological feature. Charred material recovered from a secondary context in earthwork sites can be useful in establishing chronologies as it produces relative, rather than specific, radiocarbon age determinations. Ascertaining what event an assay is actually dating is dependent on careful stratigraphic analysis and interpretation of site formation processes in this heavily altered landscape.

Within an overall architectural plan that relies on both the topography and the ultimate function of the feature, construction requires the procurement of fill material from near the site. Each donor location has its own depositional history that could include cultural horizons. These occupation surface(s) can be stripped off during construction episodes and redeposited to create seemingly primary cultural strata or be buried in construction fill or erosional material. Redeposited layers are not always clearly recognizable, especially the heavily mottled units that are easily misinterpreted as basal saprolite.

A chronology for terrace construction is established by the radiocarbon dating of several fill episodes, avoiding the assumption that greater depth equals older age. As dateable material collected in a secondary context must derive from an event prior to its deposition, charcoal from a fill or erosional stratum gives a *terminus ante quem* for that layer since it cannot have been deposited before that date. This same assay does not provide a *terminus post quem* for the stratum since the layers below are from various donor sites or in situ deposits of lesser or greater antiquity. Additionally, strata above the single assay might be younger or older.

Therefore dating of several fill or erosional episodes tightens the construction chronology considerably with the youngest assay in the sequence providing the last period of terrace construction or reconstruction and the oldest assay indicating anthropogenic activity in the area whether or not associated with the earthworks. Since a thick erosional deposit is probably anthropogenically induced, a radiocarbon date from the deposit indicates upslope cultural activities possibly related to deforestation or earthwork construction.

Generally, creating a timeline for the construction and use of the earthworks, as well as for prior cultural activity on the landscape, requires integrating radiocarbon assays originating from secondary depositional units with securely dated features. These features are commonly found in earth structures if sufficient area is exposed. Features representing ultimate use are often buried by slopewash or aeolian deposits, unrecognizable due to weathering of the early stone architecture or actually a by-product of continued activity in the area not associated with the terraces themselves.

7.2 Radiocarbon Assays

A total of 213 radiocarbon dates, all on wood charcoal, originate in interior earthwork contexts. Thirty-three of the assays are first reported in these investigations (Table 18). In the majority of cases, charcoal samples were collected as point-provenienced samples directly from subsurface features or cultural layers on stratigraphic profiles. Samples were not extracted from bulk soil collections or from the screen. This method ensures secure provenience data and often allows for the collection of one taxon per charcoal sample.

Most of the charred wood samples were identified to taxa by Gail M. Murakami at the International Archaeological Research Institute, Inc. Wood Identification Laboratory prior to being submitted for radiocarbon dating. The primary objective of wood identification is to determine sample fitness for radiometric dating by reducing the error caused by long-lived taxa, eliminating historical introductions or foreign driftwood and ensuring fossil fuels are

removed from the sample.¹⁸ Charcoal identification is also useful in paleoenvironmental reconstructions, to better understand the environment being inhabited and in identifying cultural preferences for resource use and collection. Table 17 lists the newly identified charcoal taxa with their common English and Palauan name, whether the plant is native or introduced, its habitat and known traditional uses.

The thesis charred wood samples and most of the previous charcoal samples were processed by the University of Waikato Radiocarbon Dating Laboratory. All samples were pre-treated with acid/alkali/acid and most were analysed by accelerated mass spectrometry (AMS) with the few of sufficient size (over 2 g) dated by conventional methods. Radiocarbon ages were calibrated using OxCal v.3.10 software (Bronk Ramsey 2005, atmospheric data from Reimer et al. 2004) at two standard deviations (95.4% probability) using the INTCAL04 calibration curve.

Application of standard protocols for chronometric hygiene (Anderson 1991; Spriggs and Anderson 1993) adapted to a Palauan context (Liston 2005) removed 48 determinations from the analysis as unreliable for establishing cultural sequences. One sample in the current charcoal assemblage produced anomalous results and was removed from the analysis to leave 165 total radiocarbon assays including 33 new assays. Information on provenience, event dated, material and results of all 165 assays is presented in tabular form in Appendix E.

The majority of the earthwork charcoal samples were recovered from intact cultural features and cultural fill material with the potential to provide information relevant to identifying timing of specific events and construction phases. Of the 165 accepted assays, 65 (39%) derive from postmolds, garbage pits, burn events or other subfeatures, 40 (24%) are from construction fill, 39 (24%) were collected in primary cultural horizons and 17 (10%) originate in erosional deposits. The context of four (3%) samples is indeterminable and is thus interpreted as a secondary deposition.

¹⁸ Minor deposits of lignite that could contaminate the sample are interbedded with Airai clay and found in scattered patches on west and south Babeldaob (Corwin et al. 1956:53, 259).

Thirty-eight earthwork sites, in nine of the ten larger districts and one smaller district, are represented in the chronology. The samples originate in nine Type I (ridgeline), seven Type II (radial pattern), four Type III (ascending ridge) and seven Type IV (step-terrace) complexes. Also represented are seven unassigned crown complexes, three levelled areas and one step-terrace. Represented structural components include modified ridges, crowns, levelled hilltops, earth platforms, ring-ditches, basins, saddle terraces, levelled areas and step-terraces. Forty-three samples are from the summits of low or high crowns.

For this thesis, 37 point-provienced charcoal samples were submitted for radiometric dating after being identified for wood taxa. As three of the samples were too small for analysis (WK-2700, 27004, 28514), 34 samples were radiometrically dated, one of which was determined to be anomalous (WK-26997; Table 18). Although the radiometric date of 2470–2330 calBP (WK-26997) is plausible, the sample was collected from an intact potential cultivation deposit at 20 cm below surface. This same deposit produced another assay that is more recent by ca. 1500 years (WK-28516). This strongly suggests that the early date is an anomaly. The charcoal may have been mixed in with the more recent cultural deposit during Japanese Era agricultural activities.

Eighteen of the thesis charred wood samples were collected in subfeatures, eleven in intact living surfaces, three in erosional deposits and two in construction fill. Eighteen samples are from step-terraces, nine samples are from crown summits, five are from modified ridges and two samples are from gullies.

It is unlikely that all the earthwork districts were established simultaneously, developed in tandem or fell concurrently. It would hence be desirable to identify localized chronological variations in the trajectories of earthwork districts to assess contemporaneous sociopolitical units and their relationship with one another. There is insufficient radiometric data to establish chronological sequences of individual earthwork polities (Liston and Tuggle 2006; Liston 2009, 2011a). The majority of the inland assays ($n=73$, 44%) are from the intensively investigated earthwork district in Ngaraard state while the Ngaremlengui polity with 30 (18%)

assays trails far behind. Aimeliik, possibly the largest earthwork complex on Babeldaob, has not produced any accepted ^{14}C dates.

7.3 Chronological Framework of Babeldaob's Earthworks

The following chronological framework refers only to those assays from Palau's earthworks and not those collected in the Rock Islands or in traditional stonework villages of a later era. Chronological analysis is primarily presented at the regional scale, all of Babeldaob.

The archaeological chronology divides pre-Contact Palauan culture history into five major eras extending from the initial colonization of Palau (Colonization Era, pre-3100 calBP), through an expansion of settlement into the interior (Expansion Era, ca. 3100–2400 calBP), terrace construction and use (Earthwork Era, ca. 2400–1100 calBP), a period that has been little recorded (Transitional Era, ca. 1100–700 calBP) and the development of stonework architecture (Stonework Era, ca. 700–150 calBP). Table 22 synthesizes the paleoenvironment, social and cultural details of each of the chronological periods.

Of the 165 earthwork assays, the Colonization/Expansion Era contains 11 (7%) earthwork assays, the Earthwork Era 134 (81%) radiometric determinations, and the Transitional and Stonework Eras each have ten (6%) ^{14}C dates.

Colonization/Expansion Era

Earthwork construction is unlikely to have begun in Palau's Colonization Era but may have started in the Expansion Era as the growing population began to occupy Babeldaob's interior for settlements and swidden cultivation. Eleven inland charcoal samples date to the Colonization/Expansion Era. Six derive from secondary deposits, and indicate interior occupation prior to or concurrent with terrace construction. Three assays are from intact occupation surfaces, all associated with pottery sherds and buried by construction fill. The final two Expansion Era assays, both collected during thesis work, are in cultural features.

Three of these Colonization/Expansion Era assays were produced during these investigations. All three are in deposits resting on or cut into intact and shaped saprolite. This

indicates that the upper A and substantial B horizons had already been removed. One sample derived from an intact cultural deposit capping levelled saprolite in an anthropogenic terrace at the base of Ngaremlengui's Sisngebang modified outcrop. The sample of cf. *Bruguiera gymnorhiza* produced a calibrated date range of 2770–2700 BP (86.2%), 2640–2610 BP (6.5%), 2590–2540 BP (2.7%) (WK-28518).

Thesis work produced the earliest archaeological earthwork dates associated with secure cultural features. These two assays are from the extensive step-terrace complex of Ngeskebei located beneath the Sisngebang crown complex and adjacent to Ngeremeduu Bay. The samples were collected in separate small pit features that may be related to cultivation. The pits were cut into intact but levelled B/C horizons beneath terrace construction fill and produced calibrated assays of 3380–3210 BP (WK-28515) and 3260–3000 BP (WK-27005). This presents evidence that the occupants of the lowlands and high hills at the entrance of Ngeremeduu Bay were substantially modifying their environment by about 3200 calBP. The mouth of Ngeremeduu Bay is an easily defensible location and provides access to fresh water, bay and lagoon resources and the open ocean via the adjacent Toachel Mlengui channel through the western fringing reef.

Earthwork Era

The Earthwork Era (ca. 2400–1100 calBP) is archaeologically characterized by extensive clusters of inland earth architecture that supported the majority of community activities and defined sociopolitical districts. The long era is divided into three loosely bounded phases that correspond to the growth, zenith and decline of interior earthwork occupation: Early (2400–2150 calBP), Middle (2150–1500 calBP) and Late (1500–1100 calBP). Of the 134 assays dating to the era: 10 (7%) are in the Early, 87 (65%) in the Middle and 37 (28%) are in the Late Phase. Despite the focus on interior occupation during this period, where viable, habitation and cultivation of Babeldaob's coastal margin continued and played an integral role in resource procurement.

The Early Phase (ca. 2400–2150 calBP) refers to the initial period of growth and development of rudimentary earthwork forms and uses. The inception of the Earthwork Era is documented by sedimentary disconformities in the form of abrupt transitions from wetland to upland sediments in five paleocores (Athens and Ward 2002, 2005; Athens and Stevenson 2011), a change in ceramic temper from beach sand to grog (Clark 2005) and the expansion of site types and occupied area. The degree and scope of earthmoving during the Early Phase is uncertain. An intact occupational surface on Ngerulmud, a large levelled hilltop in Melekeok, dates to ca. 2350–2100 calBP (B-140186) indicating levelling hills was an early construction technique. High ridgelines such as Tabelmeduu in Ngaraard were being levelled by about 2320–2040 calBP (B-236596).

Two thesis wood samples date to the Early Phase. One assay is from the basal erosional layer of an anthropogenic gully in the large swale at the Ked era Aranguong complex. The charred cf. *Glochidium* species produced a calibrated assay of 2500–2340 BP (80.8%), 2690–2630 BP (12%), 2620–2590 BP (2.6%) (WK-28530). This date may be associated with deforestation for swidden agriculture along the banks of the Ngermeskang River. The second assay derived from construction fill placed directly on cut saprolite in the saddle terrace at Ongelwatel, below the Sisngembang crown complex. The charred remains of cf. *Artocarpus altilis* delivered a date range of 2490–2330 BP (93.6%), 2670–2640 BP (1.8%) (WK-27009). The date identifies the first large scale construction event and suggests that the terrace may have been first constructed by ca. 2300 calBP although additional assays are needed for confirmation.

The Middle Phase (ca. 2150–1500 calBP) is characterized by monumental architecture in the form of massive earth structures and large expanses of modified terrain that represent bounded polities. Structural remains on the already shaped Ngemeduu crown are dated to ca. 2000 calBP (Phear 2007:320) although whether this substantial hilltop modification included elevating the summit is uncertain. Due to the high level of construction activity adjacent to the Roismelech crown and on the Ngedelchong crown it is highly probable that the hillslopes were carved into steep sides in tandem with the complete alteration to the hilltop at ca. 1900 calBP.

Their construction contributed to the cultural landscape that accrued over several centuries to culminate in extensive clusters of conjoining earthworks. Ngaraard's earthwork district spanned ca. 12 square kilometres by at least 1900 years ago with the Ngiwal cluster dated to the same period. Certainly by this time substantial terrain along the inner margins of Ngeremeduu Bay and the banks of the Ngermeskang River inland to the ridge were shaped into large potentially contiguous terrace structures. The earthwork districts in Ngaraard and Ngiwal, and perhaps elsewhere on Babeldaob, appear to have reached their zenith in size about 1700 BP.

Nine thesis samples date to the Middle Phase. Two of these are from the deeply buried living surface containing the prepared surfaces with whole pots at Roismelech. The samples, both identified as *Intsia bijuga*, produced calibrated date ranges of 2000–1860 (93.1%), 1850–1830 BP (2.3%) (WK-29178) and 1990–1820 BP (WK-29179). In addition to dating a significant ritual or ceremonial event to ca. 1900 BP, this date gives a *terminus ante quem* for the first large-scale construction phase that removed the B horizon and a *terminus post quem* for the second large-scale construction phase that deposited over 3.8 m of fill material onto an occupational surface containing ritual features.

Seven Middle Phase thesis dates were produced from samples collected in Ngaremlengui earthwork complexes: three each from the Ngedelchong crown and the nearby Ked era Aranguong and one from Sisngembang. The three dates from Ngedelchong indicate the constructed crown was in use by ca. 1950 calBP. Charred remains of cf. *Rhizophora* sp. collected in the bottom of the constructed basin produced a radiometric date range of 2120–1900 calBP (WK-28531). Samples from the lowest pit and fill deposits on the deeply cut saprolite next to the basin produced calibrated date ranges of 2010–1870 calBP (WK-28534) and 1900–1730 BP (WK-28532). Similar to the ceremonial or ritual cultivation basin in the Ngedelchong crown is the deeply buried dark moist deposit lying on bedrock on the Sisngembang outcrop crown. A chunk of cf. *Cocos nucifera* collected in this pit dates construction of the crown and possibly ritual related cultivation to at least 1740–1560 calBP (WK-28520).

Three thesis assays on the terraced south arm of Ked era Aranguong indicate that this well-located complex may have supported a habitation area by at least ca. 1700 calBP. It is likely the site was occupied long before due to the earlier dates on the nearby Ngedelchong crown its excellent location along the river's floodplain. Charcoal from the base of two wide pit features cut into the saprolite at either end of the south arm rendered calibrated radiocarbon date ranges of 2120–1920 BP (WK-28525) and 1830–1690 BP (88%), 1670–1620 BP (7.4%) (WK-28528). A charcoal sample retrieved from a thick lens of burned *Arecaceae* in the lower of two intact living surfaces produced a ^{14}C date range of 1710–1550 calBP (WK-28527).

The Late Phase (ca. 1500–1100 calBP) saw comparatively minor construction of inland earthworks beyond old polity boundaries, marking the decline of the powerful interior districts. Northeast Babeldaob's inland earthwork districts may have been substantially reduced in size and perhaps largely abandoned by about 1400 calBP.

Large-scale construction is thus far only identified in the first half of the Earthwork Era. Construction events continued throughout the remainder of the period but on a relatively minor scale. It appears this entailed remodelling the massive complexes by adding rather thin layers of construction fill such as at Ked era Aranguong, infilling crown basins like at Sisngembang and Ngedelchong and adding knobs and berms onto crowns, for instance Roisingang and Sisngembang. More modest structures were built outside of the districts, such as at Isakos. It is likely maintenance work on already constructed features was a continual task. This does not suggest that earthworks were no longer occupied; only that the substantial engineered complexes and orchestrated work forces were no longer a significant part of the sociopolitical leadership strategies.

Eight thesis radiocarbon dates are associated with the Late Phase: one from Ked era Aranguong, three from Ngeskebei and four from Sisngembang. An erosional fill inside a drainage ditch in the constructed gully in the Ked era Aranguong swale produced a radiocarbon date range of 1400–1300 calBP (WK-28529). The date indicates the gully could have been infilled anytime after ca. 1200 calBP.

Fill in two pits in the large deep basin constructed in the eastern third of the summit of the Sisngembang outcrop produced two date ranges of 1385–1295 calBP (WK-28522) and 1270–1080 calBP (WK-28523). A large chunk of *Intsia bijuga* collected in a pot cache in the middle of the central terrace on the outcrop's summit yielded a calibrated date range of 1290–1170 BP (WK-28521). The pot cache may be associated with an unidentified burial or it could be associated with a ritual event tied to the basin. The pot cache deposits cover the lower basin subfeature that was in use about 400 years earlier at ca. 1650 calBP. The terraced terrain at the base of the outcrop was also occupied at this time. A charred wood sample in a small pit cut into saprolite beneath almost a meter of fill material on this lower terracing delivered a ^{14}C date range of 1300–1170 calBP (WK-28519).

Three assays in the Ngeskebei terrace area below and east of Sisngembang overlap with use of the basin and the pot cache on top of the outcrop. An assay of 1530–1380 calBP (WK-26998) was produced from a cf. seed embryo collected in construction fill. Two large pits, one a garbage dump, cut into levelled saprolite produced calibrated date ranges of 1280–1080 BP (WK-27006) and 1270–1070 BP (WK-27003).

Transitional Era

Current archaeological data suggests a Transitional Era (ca. 1100–700 calBP) of several hundred years after the dissolution of at least some of Babeldaob's large interior earthwork districts. During this time little cultural activity is scattered across the island's hills and coasts. In the Transitional Era, there is comparatively minor construction of inland earthworks beyond the old district boundaries.

Four ^{14}C assays collected during the thesis work fall within the Transitional Era: one from Nkebeduul, one from Ked era Aranguong and two from Sisngembang. Erosional fill in a water control ditch at Nkebeduul, a Type I ridgeline complex on the banks of a river by the same name, contained charred wood dated to 1190–1050 calBP (86.1%), 1260–1200 BP (9.3%) (WK-27010). One of several burials in the berm on the Sisngembang outcrop dates to 1180–980 calBP (WK-28524). The extent of erosion intruding into the west side of Sisngembang's basin

suggests that the burial berm on the higher central terrace may have been constructed, or reconstructed, concurrently with the infilling of the basin. An intact cultural deposit in the terraces on Sisngembang's lower floor yielded an assay of 1180–980 calBP (WK-28517).

A 500 to 600 year gap in the sixth assay from Ked era Aranguong suggests the site may have been abandoned during the Transitional Era. The complex could have been restructured before it was reoccupied as evidenced by the 20 cm of construction fill separating the upper living surface, dated to 735–670 calBP (WK-28526) from the lower intact occupational surface, dated to 1710–1550 calBP (WK-28527), on the site's south ridge.

Stonework Era

A dramatic and abrupt rise in coastal lowland radiocarbon assays beginning around 700 calBP or a little earlier is countered by very few post-700 BP inland assays. This marks the beginning of the Stonework Era (ca. 700–150 calBP) when the population returned to a more coastal settlement pattern and a subsistence economy based on pondfield cultivation. Near-coastal step-terraces supported stonework villages and associated dryland fields and some ancient crowns served as lookout or signal towers.

Seven thesis wood charcoal samples date to the Stonework Era: one from the Nkebeduul ridge, one from the Ngedelchong crown and five from the Ongelwatel ridge and Ngeskebei step-terrace complex. An intact cultural deposit, dated to 670–550 calBP (WK-28516), at Nkebeduul is associated with stone facing and a stone platform. An intact occupational deposit capping the construction fill that levelled the Ngedelchong crown contained a sample of cf. *Parkia parvifolia* that yielded a ^{14}C assay of 470–300 calBP (WK-28533). This may identify the intentional infilling of the crown's basin so that the summit could serve as an observation post or signal tower for the nearby stonework village of Ngesisech.

The five overlapping ^{14}C dates from the Ongelwatel ridge and Ngeskebei step-terrace complex indicate they were both heavily occupied and reconstructed between 545–260 calBP, during the Stonework Era. At this time, both complexes contain stone pavings associated with

structures identified by postholes. As in earlier eras, Ngeskebei was almost certainly being cultivated at this time. The Ongelwatel paving was constructed at 510–420 BP (49.9%), 410–310 BP (45.5%) (WK-27008) on top of an intentionally placed whole pot. Ngchemesed stonework village is connected to both the complexes, and it is likely their use is associated with the village's activities.

The relatively large number of Stonework Era assays produced in earthworks during this work is a reflection of the proximity of two important Stonework Era villages. The long abandoned stonework village of Ngesisech is within half a kilometre of Ked era Aranguong and Ngedelchong. Villagers from Ngesisech would have perhaps crossed, and continued to use, both sites as they made their way to the Ngermeskang River. Ngchemesed stonework village is directly below Sisngebang and adjacent to Ngeskebei.

The association of earthwork complexes inhabited early in Palau's cultural sequence and stonework villages important in traditional history attests to the potential of these areas for significant continuous occupation.

7.4 Summary

Ngaremlengui's southwest corner, now called Ngchemesed, with the conjoining Ngeskebei/Sisngebang/Ongelwatel and other terrace complexes, contain the earliest archaeological dates associated with cultural features in earthwork deposits. There is a possibility that by 3380–3000 calBP, the landscape was being modified by removing the thick B horizon and levelling the underlying saprolite. This may indicate that landscape modification began almost immediately after colonization. With an easily defensible location, access to fresh water and bay and lagoon resources and directly in front of the west coast's primary channel through the western fringing reef, Ngchemesed is a prime location for early settlement.

The chronology indicates that after developing over about a millennium, Palau's earthworks attain monumental proportions in both structural size and extent of modified

terrain about 1900 calBP or a little before. The distributional patterning of expanses of contiguous modified terrain defines sociopolitical districts that are the focus of activity until ca. 1500 calBP when some polities begin to decline in power. It is not until possibly 1100 calBP or a little later that earthworks are essentially forsaken as components of integrated sociopolitical districts.

Large-scale terrace construction may have been confined to the first half of the Earthwork Era with further building regulated to smaller structures, stabilization or relatively minor remodelling. Earthwork use was not terminated outright once the earthwork polities were no longer as powerful. This may have been largely confined to re-use of the larger structures as defensive features, crown summits as graveyards and the low step-terraces to support structures and the dryland fields bordering near-coastal village complexes. Monumental architecture was re-established on Palau around 700 calBP in the form of extensive and elaborate stonework structures.

In the remainder of Oceania, architecture did not attain monumental proportions until about 800 years ago or perhaps a little later (Kirch 2000; Smith 2004; Clark and Martinsson-Wallin 2007), about a millennium after it emerged on Palau. Babeldaob's monumental earthworks had already arisen, served their purposes and lost their intended sociopolitical significance before other Pacific Islands began to construct such massive features. The second phase of monumental construction on Palau, in the form of elaborate stonework villages, coincides with the advent of monumentality in the rest of the Pacific.

To begin to examine the mechanisms behind the early emergence of monumentality on Palau and its correlation to sociopolitical development, the practical and intangible functions of the earth structures must be understood. Relating these functions to the natural environment can assist in explaining the variables involved in their construction being chosen as an adaptive strategy. This allows for speculations on how these uses relate to political economic leadership strategies and the role of earth structures in the evolution of sociopolitical complexity. As demonstrated in the archaeological record, Babeldaob's earth structures served

multiple practical uses (Liston 2007a, 2011a). The following chapters explore this archaeological data, ethnohistoric records and the properties of the natural environment to examine the multiple roles of earthworks in agricultural, ritual, symbolic and defensive activities. These activities are then associated with network and corporate political economic strategies.

8.0 AGRICULTURE AND STEP-TERRACES

Agricultural production is a critical element in the sociopolitical development of Oceanic chiefdoms (Kirch 1984, 1994, 2006; Earle 1991a, 1997). Agricultural technologies and different modes of intensification were adapted to particular island environments. Control of the staple resources produced often led to economic disparity and associated social inequality. In the Pacific, these subsistence economies supported the hierarchical chiefly societies (Cordy 1981; Hommon 1986; Allen 1991; Kirch 1994, 2010; Earle 1997).

Currently, Babeldaob's subsistence economy relies almost solely on taro cultivation in intensive pondfield systems along the coastal margin. Inland step-terraces lie abandoned. Yet, the most archaeologically advocated explanation for step-terrace use is for agricultural production. With few oral histories or ethnohistorical documentation of earthwork use and the poor preservation of botanical remains in Babeldaob's oxisols, there is no direct traditional or empirical evidence for inland step-terrace complexes supporting dryland cultivation systems. An agricultural function for step-terraces is inferred almost solely by morphological analogy with like features throughout the world (Spencer and Hale 1961).

Despite the lack of direct archaeological evidence for ancient agricultural production on Babeldaob's low step-terraces, the chapter adopts the view that many of them were primarily built for cultivation. With this assumption, this chapter explores the mechanisms behind the establishment of an inland subsistence economy and how this production system developed into landesque capital. This discussion is in particular reference to many of the low step-terrace complexes and does not suggest that all step-terrace and the other morphological types of earth structures were primarily directly dedicated to cultivation.

8.1 Models of Agricultural Development

Agricultural production can be increased by expanding the amount of cultivated land laterally onto previously unfarmed terrain or by intensifying cultivation practices (Morrison 1994, 2006; Leach 1999). The latter method is a process in which an increase in the

investment of labour and capital on a unit of land results in higher productivity (Brookfield 1972).

Widely used in the intensification of staple production systems are technological developments such as large-scale irrigation systems, terracing, fishponds, raised field cultivation and other permanent production features. The extra labour invested in this infrastructure provides long-term benefits to create a significant and valuable asset, or 'landesque capital' (Brookfield 1984; Blaikie and Brookfield 1987:9; Håkansson and Widgren 2007; Erickson and Walker 2009). Higher yields are also gained through agricultural innovations or strategies that qualitatively increase production but do not increase labour costs (Brookfield 1984; Kirch 1994). Innovations include new planting methods or tools, genetic modifications or devices that control water or erosion

The complex process of agricultural development is generally modelled by combining technological, economic, political, social and ideological factors with external variables such as climate or geomorphological conditions. Almost all models include population dynamics as a significant factor in the developmental process.

Boserup (1965) constructed an evolutionary model of agricultural development that progresses from long-fallow forest swiddening to multicropping in permanent fields. She proposed that new agricultural strategies, technological innovations and increased labour are tied to declines in the food supply due to population pressure. This population-driven viewpoint is criticized as being unilinear and restrictive of the potential of other catalysts and strategies (Morrison 1994; Leach 1999). Many measures can affect production levels to influence agronomic success, including specialization, diversification, expansion and cultural institutions and behaviours (Brookfield 1972; Kirch 1994). The organization and management of labour can also strongly influence crop yields.

Brookfield (1972) recognized agricultural production as being affected by social institutions as well as the physical requirements for caloric consumption. Social production of food, or food "produced for the use of others in presentation, ceremony and ritual, and hence

having a primarily social purpose,” may not be economically efficient but may secure social merit (Brookfield 1972:38; Hayden and Villeneuve 2011). By providing an incentive for innovation and intensification, these external economic factors induce productivity. In a political economic perspective, sociopolitical power achieved through social merit can be a strong motivating factor in agricultural intensification (Earle 1991a, 1997).

Rather than focus on increasing production, evolutionary ecology models of agricultural development concentrate on the efforts used to maintain a stable economy by examining the contrasting behavioural or reproductive strategies of risk management and aversion (Ladefoged and Graves 2000; Allen 2004). These strategies mediate the unpredictable variations in the natural or social environment by technological innovation, diversifying crops, trade and exchange relationships, relocating and storage (Madsen et al. 1999; Winterhalder and Smith 2000). Bet-hedging strategies predict that populations in stable predictable environments will maximize benefits through risk aversion while populations in temporally variable environments will minimize variance through risk management (Dunnell 1989; Madsen et al. 1999).

8.2 Evidence for Interior Cultivation Systems

Although capable of supporting crops (see the following), there is no evidence Babeldaob’s step-terraces functioned as Earthwork Era production systems. Their ancient use as agricultural systems is inferred by morphological analogy with the global use of step-terraces to grow crops.

Archaeological investigations designed to produce data identifying an agricultural function for step-terraces have proved futile in large part due the poor preservation of botanical remains in Babeldaob’s oxisols. Sediments collected from inland terraces reveal no evidence of cultigens (Henry et al. 1996; Liston 2008; Phear 2008). Lucking’s (1984:132–135) documentation of an Alb horizon as physical evidence of ancient step-terrace cultivation probably dates to events in the late Stonework Era or Japanese administration.

Another attempt to identify potential earthwork cultivars was made during the course of these investigations. Ten bulk soil samples from potential agricultural deposits were submitted to PalaeoWorks Consulting at the Australian National University for pollen characterization studies (Table 21). The pollen content in ten of the submitted sample was non-existent, one sample was dropped from the analysis and three samples are waiting detailed analyses.

Palau's oral histories, ethnohistoric data and land use terminology supply little evidence for pre-Contact cultivation of inland step-terraces. By the late 1700s, when sustained Western contact began, coastal taro pondfield systems had long been the primary means of crop production and the majority of the interior step-terraces lay abandoned and unproductive. The single reference to interior agriculture in traditional narratives is a version of the legend concerning the origin of taro cultivation. In the narrative, the goddess Iluochel (Milad) travels the length and breadth of Palau creating wetland taro patches. She cultivated a single dryland system, on the slopes of Ngaraard's Ngulitel complex (McKnight and Obak 1960:7). Interestingly, step-terraces, where rain-fed cultivation is expected, are a minor component of Ngulitel, Palau's largest and most impressive Type IIIa crown complex.

Babeldaob's ancient step-terraces are known to support recent cropping systems. During the early 1900s, widespread Japanese plantations grew historically introduced aluminium tolerant crops (e.g., pineapple, *Ananas comosus*; cassava, *Manihot esculenta*) on step-terraces for personal consumption and export (Iida 2012). These crops continue to be produced in the relatively few dryland gardens; all confined to small step-terraces close to occupied coastal villages. Ngiralmu and Bishop (1999:102) describe dryland taro cropping on step-terraces in Melekeok in the mid-1980s:

Trees are left at the top of the slope to retain the soil. Taro is planted on the step terraces. Within each step terrace, a furrow is made. Planting material is laid sideways in the furrow, towards the rising sun. The reason for placing taro sideways is "taro grows up, not down." Leaves are placed on the side of the taro in the furrow. After about two months, the furrow is covered lightly with soil. In another two months, more soil is mounded over the taro, "to take advantage of the increased nutrients in the upper layer of the soil." A mulch of

cut weeds, as well as artificial fertilizer, is used. The living fence is also a source of plant food.

Despite step-terraces lacking evidence of their use as agricultural features, other forms of interior cultivation are suggested in the archaeological record. Inland sites in Ngaraard and Ngaremlengui display deeply buried series of small round-bottomed pits, similar in size and shape to pits traditionally used to grow yams or dryland taro across the tropical Pacific. Also exposed are large pit features that may identify ancient breadfruit fermenting/preserving pits. Raised fields, mounds or bedding systems have not been identified in Palau's prehistoric record.

Interior basins, a form of pondfield, are just now being identified in the archaeological record. The basins are currently covered in erosional material but are likely found at the base of gullies and ditches and adjacent to larger rivers. Basins have been found at Tabelmeduu (Liston 2008), Site NA-4b (Liston and Rieth 2011) and on the top of several crowns (see Chapter 9.3). Deep step-terraces along the coastline next to the mangrove swamp contain small pondfields crossed by stone paths that date to about 1700 calBP (Liston 2011b). These basins or simple pondfields do not appear to form complex wetland cultivation systems as do those associated with the later Stonework Era villages. However, if the extent of basins is as large as the low-lying land around the Type I, II and IV complexes suggests, they would be capable of producing substantial yields of wetland taro.

Archaeologically, the lack of associated surface features and artefacts supports the use of low step-terraces as agricultural features. Also suggestive of field systems are the ditches just unearthed in a step-terrace and a gully during thesis work.

Clear identification of an agricultural use for step-terrace complexes needs to be accompanied by placing Earthwork Era cultivation in its historical and environmental context. The role of step-terraces can then be examined within the larger settlement system to understand the mechanisms behind their construction.

8.3 Environmental Motivation for Step-Terrace Production Systems

Island settlers moved inland to produce crops for multiple reasons, perhaps the most persuasive being the lack of available wetlands to support the needs of a growing population. A developed dryland cultivation technology also reduces dependence on swamp agriculture that is susceptible to drought, salt-water infestation due to typhoons and insect infestations (Lucking 1984:167; Morgan 1988:12). When moving inland to produce crops, it is probable that slash and burn cultivation would be the first technique employed due to the effectiveness and simplicity of the system in areas of thick forest growth.

On sloping land, such as on Babeldaob, forest clearance due to swidden cultivation results in washing away the fertile topsoil. Regardless, through careful management many swidden systems throughout the world persist for centuries on sloping land. Step-terraces to prevent erosion are not absolutely necessary to maintain agricultural productivity. Therefore, the immense amount of energy devoted to building and maintaining step-terrace cultivation systems does not seem to justify their agricultural return unless there are compelling reasons behind their construction.

In the following section, Babeldaob's edaphic conditions, topography and climate are examined in the context of agricultural production to explore why step-terraces would be chosen as an intensification strategy.

8.3.1 Erosion Control

Deforestation, cropping and earthmoving trigger or vastly accelerate the natural processes of soil erosion and sedimentation to cause land degradation (Blaikie and Brookfield 1987; Lal 2001). The silty clay soils on Babeldaob's moderately to steeply sloped terrain are highly susceptible to mass wasting once its protective vegetation is removed. Without forest cover, the fragile tropical topsoil containing nutrient-rich humic material and any additives needed to keep the soil fertile is easily washed away (Smith 1983:43). In addition to depleting soil nutrients, this downslope soil movement affects lagoonal resources and fresh water sources.

Due to the erosion prone soils, swiddening on Babeldaob's sloped land would rapidly eliminate topsoil and cause enormous sedimentation. In order to continue to use the interior for cultivation, erosion control strategies to prevent land degradation would have to be implemented. Furthermore, with over 80 percent of Babeldaob's soil highly infertile, loss of good soil because of erosion can be disastrous to the subsistence economy.

Bench, or step, terraces effectively stabilize slopes to slow the processes of erosion (Dunning and Beach 1994; Treacy and Denevan 1994). Additional landscape engineering techniques that could be used in conjunction with terracing to limit erosion include diversions, ditches, dikes, and vegetated or stone-lined drainages and slopes. Vegetative barriers, riparian buffer zones, mulching and appropriate cultivation systems such as cross-slope farming, agroforestry and slash and mulch cultivation systems also reduce soil loss. Many of these practices also slow and direct water flow, retard weed growth, add organic matter and elevate the water infiltration rate to increase soil fertility.

'Soil loss tolerance' is the maximum amount of erosion at which plant growth can be maintained within the soil. For the Aimeliik-Palau map unit, the soil loss tolerance level is determined to be 11.2 metric tons per hectare per year (Gavenda et al. 2005:2). This number derives from the estimated amount of soil created each year; hence, the soil created is equivalent to the soil lost. The U.S. Department of Agriculture, Natural Resources Conservation Services (NRCS) approximates that erosion from areas farmed using the traditional Palauan method of agroforestry occurs at rates below Palau's soil erosion tolerance level (Gavenda et al. 2005:5). It is therefore reasonable to assume that cultivation could be sustained in the interior despite what appears to be a considerable quantity of erosion.

However, the NRCS figures only pertain to cultivation practices. As evidenced in Compact Road construction, regardless of the substantial efforts made to minimize soil loss, elimination of forest cover and construction and use of earthworks is certain to generate copious amounts of erosion.

8.3.2 Water Management

With a current mean annual rainfall of 360 cm and mean annual temperature of 27.6°C environmental conditions in Palau are suitable for dryland cultivation of taro and other crops. As Babeldaob's volcanic soils are slowly permeable with a high water-holding capacity (NRCS 2010), the abundant precipitation and almost daily short downpours are sufficient to sustain dryland crops if rainfall is carefully directed. During the rainy season, drainage to prevent waterlogging is essential for dryland cultivation on Babeldaob. While in the dry season and during periods of drought, run-off must be trapped to retain moisture. Effective water management strategies can steer water both away from and onto sensitive areas.

Dependant on ancient precipitation rates, water control may be as, or more, important than irrigation. Overlapping with erosion control devices to some extent, water control features include step-terraces, diversions, grassed or stone-lined ditches and vegetative barriers. Stone mulching, found in other Oceanic islands, is unnecessary due to the high water retention in Babeldaob's soils. There is no archaeological evidence of stone mulching in Palau's step-terraces.

Interior Babeldaob's most evident water control strategies are the surface ditches and gullies truncating ridges and descending the length of earthwork complexes. These features act as storm drains to divert water flow away from living areas and more unstable architectural elements and towards cultivated fields and catchment basins. Water flowing down gullies irrigates crops on small step-terraces purposely located in the gullies to catch this flow (Figure 19). Any remaining water empties into swales at the base of the gully that contains fertile soils displaced during earthwork construction and use. Some ditches drain into backsloping terraces and basins built to hold water and fertile erosional soil and create interior cultivation ponds (Lucking 1979:6; Liston 2008, 2011b).

The complexity and extent of the water management system used in Babeldaob's earthwork structures is just being recognized. Small ditches cut into a step-terrace tread at Nkebeduul and a gully at Ked era Aranguong to guide water flow downhill were first

identified during this thesis work. Also recognized is the tilt in some step-terrace complexes that directs, retains or drains excess water (Figure 32). Extensive excavation is needed to detect the smaller or more subtle water control features that are deeply buried by erosion or construction fill.

8.3.3 Soil Fertility

Highly weathered volcanic soils, with an average pH of 4.9 to 5.3, cover 80 percent of Babeldaob. This makes Babeldaob the most infertile island per land area of any of Oceania's volcanic islands (see Morrison 1988). The soils are low in organic matter, deficient in phosphorus, potassium and other macronutrients and contain toxic levels of aluminium. The topsoil is thin and fragile while the clayey subsoils have a low cation exchange capacity (CEC).

Despite Babeldaob's poor soil properties, it is possible to grow inland crops. Limitations of low fertility and high aluminium can be overcome with soil ameliorants so that the volcanic soils can be productive indefinitely (McCutcheon 1981; Miles et al. 1994; H. Manner, pers. communication, 2010). The addition of organic fertilizers (green manure) is the key component in Babeldaob's soil health (Gavenda et al. 2005:38). Other soil enhancements include charcoal ash, manure, seaweed and fishmeal (McCutcheon 1981; Miles et al. 1994; Ragone 1997; Ngiralmu and Bishop 1999; Gavenda and Nemecek 2006). Adding calcium carbonate (CaCO_3), prevalent in Palau's calcareous sand and coral, lowers the soluble aluminium and neutralizes soil acidity by increasing the CEC. Calcium carbonate particles measuring ≤ 0.1 mm in diameter are the most effective but would require pulverizing the limestone.

The effectiveness of soil management is exemplified by experiments in Babeldaob's *dechel* or marshland systems where the addition of soil supplements produced a three-fold increase in yield (Del Rosario and Esguerra 2003:2). Thus far, traces of early anthropogenic soil amendments are not archaeologically, biologically or chemically detectable although it is probable these strategies extend far back in time.

Other strategies used to retain Babeldaob's soil health and productivity include planting nitrogen-fixing legume plants, crop rotation and intercropping. In addition to soil enrichment, many of these practices also lower soil temperature, reduce weeds and pests and decrease evapotranspiration.

Because of these mandatory soil additives, maintaining fertility on step-terraces is labour intensive. To eliminate the harmful effects of aluminium and raise the soil pH to 5.5 or higher, between two and four tons of CaCO_3 per hectare must be added to the soil (NRCS 2010:144). In addition to chicken manure and inorganic fertilizer, Del Rosario and Esguerra (2003:6) broadcast 750 kg/ha of lime during preparation of their experimental dryland field. Hauling immense amounts of coral or sand from the lagoon up to the terraces, crushing it into more effective particles and dispersing it through the fields is a demanding task. Also labour intensive is the collection, stockpiling and dispersal of crop residue, mulch and other organics.

8.4 Traditional Subsistence Strategies

Although not without major management issues including high aluminium saturation and iron content, Babeldaob's most agriculturally productive soils are the Mesei-Dechel-Ngersuul and Odesangel units found in the alluvial bottomlands. Soil fertility is not a major issue in cropped areas of bottomland soils if organic matter in the form of crop residue or mulch is returned to the soils. Ragone (1997) documents that to maintain the fertility of a 3.6 m² pondfield, 24 kg of grasses must be added the first year with only 6 kg required the second year. Palau's complex system of wetland taro production ensures the replenishment of biomass.

The majority of farming currently practiced in Palau is the intensive cultivation of taro pondfields (*mesei*) in these alluvial bottomlands; generally freshwater swamps just inland from the coastal margin. Wetland taro (*Colocasia esculenta*, *kukau*) produced in the pondfields is a highly valued prestige good with the condition of a woman's *mesei* and its crops an indicator of her status. Also currently practiced is *dechel* cultivation, a less intensive planting system in marshes where vegetation is cleared but the sediment is not turned under. While pondfields

continually produce, *dechel* land must lie fallow for five years after two years of production (McCutcheon 1985:175). Except when growing the historically introduced cassava and pineapple, dryland farming is relatively uncommon. Occasionally *C. esculenta* is currently grown in dryland fields (Figure 69).

In ancient Palau, it is unlikely either *mesei* or *dechel* forms of wetland cultivation were the primary subsistence strategy. As in Aneityum (Spriggs 1981), interior cultivation was possibly far more extensive than lowland wetland systems due to the limited availability of bottomland soils. Arable wetlands best suited for taro cultivation were largely restricted to the mouths and floodplains of Babeldaob's major riverbanks and narrow streambeds. There may have been limited wetlands along those few sections of Babeldaob's coastline not bordered by a low bench. Here, non-intensive cultivation of both *Cyrtosperma merkusii* (*brak*) and *C. esculenta* likely persisted from the time of initial settlement. The high yields and low labour inputs for swamp cultivation probably induced settlers to primarily rely on this agricultural strategy whenever possible.

This lack of wetlands for food production would result in settlers expanding into the interior to implement swidden systems. Paleoenvironmental evidence and the extent of current grasslands strongly suggest that swidden cultivation was extensively practiced on Babeldaob early in the cultural sequence (Athens and Ward 2005; Costion et al. 2012). Although about a millennium earlier than current archaeological evidence of human colonization, Athens and Ward (2002, 2005) propose that large-scale slash and burn techniques began about 4300 years ago on Babeldaob. This is implied in the fossil pollen/spore record by a significant correlation between a surge in grasses, ferns and other savannah vegetation (*Poaceae*, *Lycopodium*, *Pandanus* spp.) and a dramatic rise in microscopic charcoal particles. The differential timing of early savannah formation between Micronesian islands and within Palau indicates this transformation in biota is not climatically induced but anthropogenic and related to variations in the timing and spatial distribution of settlements and associated fields (Athens and Ward 1998, 2004, 2005; Athens et al. 2004).

Despite providing expanses of land, Babeldaob's interior contained its own array of environmental constraints. Not only was it almost entirely covered in thick forest but also its highly weathered volcanic soils rapidly become infertile without adequate conservation measures. Swidden fields (*telemtumul*) receive a short-term increase in soil nutrients due to the introduction of organic matter but successful cultivation could only last for a short duration. Lacking nutrient cycling from leaf litter, repeated clearing and burning would soon transform the thin nutrient-poor soils in the previously forested areas into nonarable earth. Without crop rotation and extensive soil management, swidden plots in Palau's easily exhausted tropical soils are only productive for approximately three years after which the plot must bush fallow for about 15 years to allow the soil time to replenish (McCutcheon 1981; Hunter-Anderson 1991; Ragone 1997). Once a swidden plot was no longer productive, farmers moved to a previously unexploited area and begin the swidden process anew.

As suggested for Tikopia and Kosrae (Kirch and Yen 1982; Athens et al. 1996), swiddening may have only been practiced for a short time until other cultivation methods were established. On Babeldaob, one of these methods was probably the step-terrace complexes constructed as intensive inland agricultural features. In part, these step-terraces were mandatory measures to reduce erosion and maintain soil fertility in Babeldaob's particular edaphic and climatic conditions. With a lack of nearby water sources and no evidence for an irrigation system, the step-terraces probably supported rain-fed dryland cultivation assisted by water control features such as ditches and gullies.

Palau's ancient subsistence economy likely employed a mix of dryland cultivation (*sers*), non-intensive wetland cropping in basins dispersed throughout the terraces and riverbanks, mixed tree gardens (*chereomel*) and, possibly, slash and mulch (*telemtumul*) horticulture (Kubary 1892; Barrau 1961; McCutcheon 1981; Hunter-Anderson 1991; Manner 2008). These subsistence systems overlap in resources and methods to some extent with the prevailing concept of integrating multi-storied crops of food, medicine, weaving and construction material, and other economically or ritually useful plants. Agroforestry is especially effective on Babeldaob as it provides shade to understory cultigens, reduces evapotranspiration, and the

trees and shrubs remain standing to supply leaf litter to recycle nutrients back into the soil. It also reduces the risk of environmental disaster due to pests, climatic fluctuations, and other natural deterrents and prevents environmental degradation (Clarke and Thaman 1993; Latinis 2009).

As the acidic oxisols commonly destroy pollen and phytoliths, the cultigens and other ceremonial and economic plants that grew in the interior is unknown. A wide range of cultigens that are not as sensitive to high levels of soluble aluminium and could flourish with proper maintenance were available for interior dryland cultivation. Step-terraces could support subspecies of *Colocasia*, banana (*Musa* spp.), yams (*Dioscorea* spp.), coconut (*C. nucifera*) and breadfruit (*Artocarpus* spp.) (McCutcheon 1981; Lucking 1984:144; Masse 1989:69; Hunter-Anderson 1991). Typical cultigens that Babeldaob's different soil types can support are presented in Table 23.

Intensive pondfield agriculture was only possible with suitable edaphic conditions. This would require 1) deposition of sufficient upland colluvial and alluvial material into low-lying areas to vastly expand the wetlands, 2) development of these deposits into highly fertile hydromorphic soils and 3) elimination of tidal influxes of salt water by sufficient sedimentation (Liston 2009; Athens 2011). As on several Polynesian islands, Palau's large-scale irrigated pondfield (*mesei*) cultivation may have begun as an independent innovation late in the cultural sequence (Kirch 2006:199)

However, wetland cultivation in basins and lowlands created at the base of huge terrace complexes appears to have begun early in the cultural sequence. This less intensive form of wetland cultivation was practiced throughout the Earthwork Era. The intensification of wetland production by constructing pondfields probably did not begin until the latter part of the Transitional Era (ca. 1100–700 calBP) with more intensive development during the Stonework Era (ca. 700–150 calBP). It was at this time that dryland cultivation of the step-terrace systems may have considerably tapered off.

The move between intensive dryland and wetland taro producing systems is based on the assumption that given the opportunity, the population would make a strategic economic choice to become less reliant on dryland step-terraces and choose to develop pondfield systems.

8.4.1 Yields and Labour Requirements

Wetland cultivation provides a considerably higher more reliable yield of taro per hectare than dryland cultivation and, in most cases, is less labour intensive than dryland systems (Spriggs 1981:177; Kirch 1994).

Whereas labour requirements for Pacific rain-fed systems are ca. 1167 work days/ha per year given a six-hour workday (Yen 1973, in Ladefoged et al. 2009:2381) irrigated agriculture only needs ca. 583 work days/ha per year (Spriggs 1984). These figures do not take into account Palau's specific labour needs related to highly infertile soils and maintenance of the fields in both the *mesei* and dryland systems. It is likely that labour requirements are substantially higher on Babeldaob although the ratio between systems may stay the same.

Construction and maintenance of Babeldaob's dryland fields is labour intensive. In addition to constructing the step-terrace complexes, there is continuous maintenance of drainages to direct waterflow and the collection and distribution of large amounts of soil ameliorants. There would be a huge investment in collecting the tons of CaCO_3 needed to maintain soil fertility. In pondfield systems, a large initial investment of labour is required to build the canals, gates and walkways that manage waterflow (McKnight and Obak 1960; McCutcheon 1981). Turning the mud, continuous fertilization with green manure, planting and harvesting contribute to the continued workload in the *mesei*.

Pacific taro pondfield yields can reach over 25 mt/ha per year wet weight (Spriggs 1981, 1984) with dryland systems producing yields between 7 to 15 mt/ha per year wet weight (Kirch 1994). However, researchers in Palau showed that pondfield cultivation was the least productive of the three cultivation systems tested (Del Rosario and Esguerra 2003; Table 24). When culturally managed, and depending on the variety, dryland cropping produced between

3.6 and 12.0 mt/ha of taro, *dechel* systems yielded between 4.3 and 9.5 mt/ha and *mesei* produced from 0.8 and 9.7 mt/ha.

The high yields of taro produced in dryland systems (Del Rosario and Esguerra 2003) substantiate the feasibility of dryland step-terrace soils as productive. This does not suggest that dryland cultivation began on Babeldaob because of higher yields. Rather, it is possible that genetic innovation and long-term cultivation of dryland taro on Babeldaob resulted in the evolution of hardy taro plants capable of producing substantial yields. Palauan women continue to find undocumented dryland subspecies of taro in Babeldaob's forests (McCutcheon 1981; A. Kitalong, pers. communication, 2010). These are likely remnants of the diversity of taro grown in the Earthwork Era dryland agricultural systems.

8.5 Agricultural Intensification and Staple Finance

Intensive agricultural production systems, particularly dryland field systems, played a key role in transformations in the Pacific's traditional political economy and social organization. Despite the preference for a strong chiefly political economy based in wetland cultivation, there is a correlation between the evolution of dryland agriculture in marginal environments and the development of chiefdoms based in warfare (Hommon 1986; Kirch 1984, 1994; Earle 1997; Kolb 1999). Once the limits of production were reached, populations practiced aggressive behaviours to expand into neighbouring lands. The motivation behind the expansion of agriculture into Hawai'i's marginal zones is related to the need for agricultural surplus to fuel competition between chiefs (McCoy and Graves 2010).

In staple finance systems this competitive behaviour largely emanates from the social meaning given food and other highly valued crops that encourages production of surplus for personal or group gain (Brookfield 1972). Surplus is used as revenue to finance competition and public works, promote alliances and trade and support craft specialization. Individual political actors and their personal factions compete with each other to control the acquisition, production and distribution of the terrestrial and marine subsistence base to accumulate social status and provide capital for sociopolitical control (Earle 1991a, 1997; Kirch 1994, 2010).

Surplus is used at the household level for exchange related to births, deaths and other rites of passage. There may be a need to generate surplus for ancestor worship and other ritual or ceremonial activities. A local leader needs labour and surplus goods as well to effectively benefit the community. All these activities can also contain a strong element of status rivalry. Currently, *C. esculenta* (*kukau*) grown in pondfields is both the staple subsistence crop and the principle food used in feasting and rites of passage where gifts of food are presented to the honourees family and to each guest. The quantity and quality of the gifts are carefully documented so that when reciprocated the gift is of equal or higher value.

On Babeldaob, it is proposed that the staple resources produced on the step-terrace systems supplied the political economy with the goods needed for tribute to support religious or elite leaders and craft or construction specialists, and in feasting activities to attract labour for earthwork construction. This resulted in the landesque capital becoming a highly valuable item, both because it produced the agricultural surplus and because of the significant investment of energy and revenue invested in its construction and upkeep.

8.6 Summary

The Earthwork Era subsistence economy probably relied on arboriculture and dryland cultivation, limited wetland taro cultivation, house gardens, and gathering of wild plants, with most of the protein food supply procured from the exploitation of littoral and marine resources supplemented by birds and bats.

In the model proposed here, Babeldaob's particular environmental conditions of weathered volcanic soils, moderate to steeply sloping topography and frequent and intense precipitation are a significant variable in the establishment of step-terraces. Water management and erosion control measures are needed to combat soil degradation, maintain soil fertility, drain and water crops and protect marine resources and fresh water supplies from sedimentation. The creation of landesque capital in the form of step-terraces was a management strategy chosen to prevent land degradation and enhance agricultural productivity. The significant investment of labour in the construction and upkeep of step-

terraces and in maintaining soil fertility bestowed a significant value to the agricultural production system.

Environmental conditions are not the sole mechanism behind agricultural intensification. The multiple and complex mechanisms that propelled agricultural development on Babeldaob likely included demographic, sociopolitical, economic and ideological factors. Understanding the variables involved in developmental trajectories takes substantial archaeological data sets and evidence that is often tenuous and difficult to produce (Leach 1999; Ladefoged et al. 2003). The model for Earthwork Era sociopolitical development presented in Chapter 11 contains some of the proposed variables and leadership strategies that motivated agricultural change and how this interacted with the evolution of complexity.

Step-terraces likely used as agricultural features are only a component of Babeldaob's monumental earthwork landscape. The terrain adjacent to the landesque capital also transformed into earthwork complexes. Identifying what these structures were used for and who benefited from their construction will assist in understanding the evolution of complexity on Babeldaob. The next chapter explores the role of earthworks in ritual practice and legitimizing ideology and how these elements converge into political economic strategies.

9.0 MONUMENTS AS RITUAL

Ritual plays an important role in the development of sociopolitical complexity (Graves and Ladefoged 1995; Earle 1997; Kahn and Kirch 2011). The ideology of the priestly class and political elites can be conveyed and imposed upon the population through ritual strategies promoting their religious and hence political authority. Materialization of this ideology through ritual symbols, monuments and ceremony creates, structures and legitimizes the hierarchy (DeMarrais et al. 1996; Earle 1997). By directing, participating in and financing ritual activity, leaders are linked with the spiritual realm to solidify and enhance their status.

The ideology in these rituals can also integrate the community and the larger polity (Rice 2009). Communal ritual activities, emphasizing the supernatural or broad community themes, undermine power struggles to unite diverse segments of society. These bonding rituals generally relate to continuity with the ancestors, the community as a group and shared themes such as fertility and renewal of the subsistence economy.

Monuments are powerful material expressions of ideology by being both highly visible and charged with multiple levels of meaning and value. The production of individual experience through building monuments and participating in ceremonial events ties architecture to secular and sacred existence. As the stage on which ritual is performed, monuments also acquire significance. By embodying these qualities monumental structures configure the landscape to create places imbued with memories, tradition and meaning. They both create and convey the dominant ideology.

Oceanic monumental architecture is often the setting for ceremonial and ritual activities used in promoting the political structure (Kirch 1990a; Graves and Sweeney 1993; Kolb 1994; Graves and Ladefoged 1995; Clark and Martinsson-Wallin 2007; Kahn and Kirch 2011). Immense structures of stone and earth contain chiefly burials (Kirch 1990a; Seikel 2011), elevate ritual dances and sporting events (Herdrich and Clark 1993), and house temples and ritual activities (Kirch 1984; Wallin 1993; Kolb 1994; 2006; Kahn and Kirch 2011).

Phear (2007:129–140) suggests Babeldaob's earthworks form a ritual landscape by encompassing elements of ritual and sacred significance used in formalizing meanings associated with the land and ancestors. As in contemporary Palauan society, ritual was likely an integral part of Earthwork Era daily life with some form of feasting, ceremony or custom occurring on terraces alongside the more secular activities. Earth structures may have supported temples or shrines such as the small Erechar Rak [Cherechararak] shrine on top of the levelled mountain of Ngeruach (Hijikata 1995:29) or chiefly meeting houses (*bai*) used as gathering places for the elite. Although the earthworks could correspond to astronomical or cosmological phenomena, correlations between earthwork orientation or form and solar and lunar events are not yet identified.

9.1 Ritual Ceramic Vessels

The display of wealth by individual or group aggrandizers demonstrates their ability to accumulate or control access to objects symbolizing and defining status and prestige. Ritual activity in Babeldaob's earthworks is often marked by ritual vessel deposition and structured deposits. As prestige goods or wealth, these vessels identify significant sociopolitical activities or social stratification by reflecting the differential distribution of valued objects (Costin and Earle 1989; Hayden 1995; Smith 1987).

Judging by the immense quantities of sherds remaining in earthwork deposits, it is unlikely most pottery vessels were prestige items of ritual significance. The context or attributes of vessels may differentiate high-status or ritual activities. Pots that are intentionally hidden or cached, placed in ceremonial-monumental locations or associated with mortuary activity are apt to distinguish a vessel's ritual use (Clark and Wright 2007:180–182). Although the correlation with a specific ritual activity is sometimes unclear, in the majority of cases a ceremonial significance is strongly suggested by their connection to a human burial or special function site and their deliberate concealment. Two forms of ritual vessel deposition are identified in Earthwork Era deposits: pottery caches and single or double whole pots (Table 25).

Whole vessels are placed upright on and between burial pits and on small pavings potentially associated with interments. Both complete pots and pottery caches, as single or groups of complete or partial vessels, are purposefully buried on the prepared surface of construction projects, inserted in construction fill, and in small pits specifically made to hold the vessels. Rightside up and upside down, many of these vessels were crushed by subsequent construction or intentionally broken before their placement.

The ceremonial intent of some vessels in shallow pits with an elaborate construction sequence can not be ascertained. This patterning of vessels in pits is commonly found in earthwork sites and its intended use may be akin to the storage function suggested for the ca. 2200 year old upright pot recovered on Ulong Island (Clark and Wright 2007). Based on the pedestal of sherds sealing the hole in the base of pot, Clark and Wright (2007:180) suggest its use for storage although they do not rule out a potential ritual association.

9.1.1 Ritual Vessel Attributes

Vessels used in ritual activities might be distinguished from utilitarian ware by special or unique decoration, form or a finer craftsmanship. Earthwork Era distinctions include thin-walled pots in Tabelmeduu caches, specialized vessel forms at the Sisngembang and Roismelech caches and the potential association of shallow oval dishes with Ngaraard gravesites.

Partly attributable to post-depositional processes, painted and decorated sherds are relatively rare in Earthwork Era deposits. Red is the primary colour used in paint, with some application of reddish-orange, orange, and less commonly white or black pigments. Although referring to wooden dishes, Kubary (1873) documents the use of powdered ochre in applying colour, while Semper (1982:44) reports the use of a mix of the common red clay and coconut oil. White is derived from lime powder (*aus*); black is from soot. As in wooden items, the sealant or varnish is identified as the *cheritem* (*Atuna racemosa*). It appears the paint was applied to a floated or smoothed surface. A combination of paint and slip was often used to display colour on the same vessel.

Painted surfaces occur on a wide variety of vessel forms, including plates, shallow oval and round bowls, lids, deep bowls, pinch pots and globular bowls. Paint was often applied to the entire interior or exterior surfaces of a vessel. The relatively infrequent painted motifs are typically simple bands in parallel, criss-crossing, diamond shaped or star patterns. Accepted radiometric assays associated with painted vessels indicate Palauan vessels were painted by at least 1800 calBP and that this form of surface decoration continued until close to Western contact (Liston et al. 2011).

Painted pottery is linked with elite activities due to the recovery of painted whole vessels in cave and rock shelter burial contexts and painted sherds in prominent crown earthworks (Osborne 1966, 1979; Beardsley and Basilius 2002; Phear 2003). In most instances, painted and decorated sherds are unearthed in garbage pits or a secondary context such as construction fill. Although not frequently occurring, this suggests that painted vessels may have been more common than previously thought and may not have been reserved solely for high-ranking individuals.

None of the vessels associated with earthwork interments (i.e., Rois, Toimeduu, Sisngembang) are painted or decorated. The vessels used as grave goods vary in form and quality. It appears unrestricted, shallow oval dishes or plates with straight-sided rims may be associated with early gravesites in the Ngaraard earthwork district. Oval dishes were a common serving dish in the Stonework Era and their presence in earthwork burial deposits could be a reflection of the contents used as offerings or the contemporaneous prevailing vessel form rather than an exclusive dedication to ritual events. Some of the pots used as burial furniture display paired suspension holes (Osborne 1966:78; Liston et al. 2011:284–285) showing their use in domestic contexts where they were hung out of the way.

Unique pot forms are associated with events interpreted to be ceremonial in nature. The vessel forms unearthed on a low coral-edged rectangle at Roismelech, dated to 2000–1820 calBP (WK-29178, -29179), are not documented in other Palauan pottery assemblages (Figure 68). The deep bowl with bands of raised clay ringing its upper third is a type not yet

encountered in the Pacific Islands (C. Sand, pers. communication, 2009). No human remains or burial pits were identified in the excavation although the majority of the terrace, including two other rectangular features that may have also supported pottery assemblages, was destroyed before being archaeologically recorded.

A pottery cache on the Sisngebang crown contained a painted and incised bowl with a 3 cm tall annular base, the only one of its kind in Palau (Figure 50). The base of Palau's five other documented footed vessels are significantly shorter and made from a clay coil rather than a slab (Osborne 1966, 1979; Liston et al. 2011). Decorated with impressed and incised motifs and brick red paint, the three well-made vessels in the Sisngebang cache were placed face down in the upper fill of a pit feature and appear to have been broken when they were covered with sediment. The cache, dated to 1290–1170 calBP (WK-28521), may be associated with ceremonial activities in the adjacent crown basin.

Specific vessel shapes or decorative techniques are not directly linked to ritual acts but highly specialized vessel forms may only be found in ritual contexts (Liston et al. 2011:262–331). Vessels with largely identical morphology, size and surface treatments are found in both secular and ritual settings. This could signify that in some instances a pot's meaning transformed from secular to ritual or vice-versa. The emphasis may have been placed on the vessel's contents or, specifically in pot caches, on the ceremonial activity. The use-life of many reconstructable vessels may have included a ceremonial function whose context was erased by subsequent construction, erosional or other events.

9.2 Ceremonial or High Status Centres

The prominence of crowns and their potential separation into secular and sacred activity areas by deep ditches (Phear 2007) identifies the significance of these features in the religious or political sphere. Within their long use-life, crowns as ritual features held ceremonial cultivation ponds, elite burials, and possibly elite meeting houses or habitations.

Crowns are overlooking but separated from habitation and general activity areas. The ring-ditches, steep, high slopes and small surface area of the crowns ensured limited access to their summit by a select few. The combination of being the earthwork's dominant component and the primary structural evidence of constrained space suggests network leadership strategies. Political figures may have had exclusive access to crown summits to perform ritual acts in view of the population that was excluded from directly participating in the ritual or ceremony. Some crowns were a stage on which a ritual was performed. Presiding over or participation of the priests or emerging elite in ritual and ceremony grants them religious authority.

The significance of crowns is expressed in Palau's oral history and contemporary culture where some higher areas (e.g., Roisang, Rois Beketei) are considered sacred (*chedaol*) because they are the home of deities or are places of worship or ceremonies (*tungl*) (Hijikata 1995:42, 135). Village elders would conduct ceremonial events to petition the gods from these interior sacred areas (Tellei 1998:122). One such place for communicating with the ancestral gods and deities was on Ngerulmud which, at ca. 3800 m², is Palau's largest known levelled hilltop (Liston et al. 1998). As Tellei explains (1998:122):

It is believed that there was once a time when Ngerulmud was used as a place where women came forth with their offerings of fermented mud (keyhole angelfish, *Pomacentrus* spp.), supposedly eating them as a group, keeping each other company while trying to appease the gods. This practice was a communal activity.

Traditional history commonly identifies crowns and terraced hills as places of magic where demi-gods (*chelib*), some malevolent, live in the form of fish and humans (Krämer 1919:11, 181). Early ethnographic sources tell of crowns supporting high status residences. An Uluang and the Desekel crowns served as foundations for the homes of the villages' high chiefs (Krämer 1919:153, 248). Magicians, priests or mediums (*kerong*) lived on the terraced mountains of Eleos in Ollei, Ngeraod in Airai and Ngulitel in Ngaraard (Krämer 1917:46; Hijikata 1995:114). In Krämer's (1929:Legend 19) version of the lengthy Milad myth, the Ngulitel crown is the location of the heavenly village where the high god, Uchelelchelib, resides and from where Terkelel (Milad's son) steals the eye of the guard to heaven

(Temedokl).¹⁹ Though the small surface area of most crowns is impractical for habitation by even a small group, they undoubtedly could have supported a single civic or ceremonial building (Phear 2007:320), perhaps an elite residence.

Ngaraard's Tabelmeduu ridgeline is interpreted as a ceremonial centre or an elite complex based on the paucity of domestic midden in contrast to the quantity and variety of atypical and specialized features of potentially ritual association (Liston 2008; Tuggle 2011:168–212). As shown in Figure 70, one such atypical feature is a rock-filled pit cut into the saprolite that was intentionally buried by construction fill for an earth platform (Liston 2008). This classic Type I earthwork complex, in use from about 2250 to 1700 calBP, rises high above the east and west coasts along Babeldaob's neck and is surrounded by massive crown earthwork sites (Figure 17).

Tuggle (2011:239–240) notes three striking elements about Tabelmeduu:

1. The extensive archaeological remains almost exclusively represent construction activities, and there is very little evidence for actual occupation of the constructed features. This suggests a limited and specialized use of this complex, not one that represents village life or long-term continuous settlement.
2. Numerous vessels were buried as part of the construction of the earth platforms. While ritual significance is highly suggestive, the nature of the overall ritual activity is far from obvious. The fact that there were no burials (or any pits that could be possible burials) certainly limits the probability of interment-related ritual but does not eliminate it. Burials may not have been in the areas of excavation, but the possibility that this was a burial preparation area should also be modelled, with the burials located elsewhere.
3. The structures are positioned on a narrow ridge and each of the three main structures (Feas. 1, 4, and 6) extends completely across the width of the ridge. This means that travel along the ridge required crossing these structures. Were the structures a destination or did passage along the ridge require some form of ritual? Another possibility is that the platforms are related to warfare and defensive positioning to keep people from crossing the ridge into the adjoining valley.

A pattern in Tabelmeduu's vessel interment was noted by Tuggle (2011) after encountering 16 caches, one of which had 20 vessels, in a single earth platform (Figure 71).

Vessels in these ceramic caches appeared to have been placed within another vessel. The deep bowls, most being sufficiently large and robust, may be the

¹⁹ Other versions of the story list this heavenly village as located on Ngaraod, a hill in Airai.

pots containing other pots or sherds that were then buried. Deep bowls do not appear in single vessel caches. Ceramic caches in separate site areas . . . exhibit similar vessel burial patterns. [Tuggle 2011:296]

There may be evidence of organized craft production in the form of an open-fire pottery kiln on Tabelmeduu (Liston 2008). If the functional interpretation is correct, the kiln's placement on Tabelmeduu suggests that pottery production was highly valued with master potters allotted socially significant areas in which to practice their craft. It is likely that Earthwork Era pottery production also occurred in domestic contexts although no other workshops are documented. Ritual, ceremonial or elite wares may have been formed in domestic workshops or specialized workshops, such as on Tabelmeduu, may have been dedicated to their production.

There are a number of topographically and morphologically similar altered ridgelines throughout Babeldaob (Figure 16). One classic example is Nkebeduul in Ngaremlengui. The excavation of Nkebeduul during these investigations produced unexpected results when the earth platforms and associated earthworks on the crest of the ridgeline produced minimal archaeological data. This may be due to the site never having been completed or occupied in its initially constructed capacity.

9.3 Ritual Cultivation

Many crowns have 'depressions' encompassing a significant portion of their small summits (Figure 14). Excavation during thesis investigations identified these depressions as basins that are now infilled with sediment. The prominent location, small size and difficulty in accessing these basins are highly suggestive of their ceremonial importance. As the basins make ineffective water catchments, it is more likely they served as a ceremonial or ritual cultivation plots. They could have been used in fertility rites presided over by priests or high-ranking individuals.

Hijikata (1993:59, 70) describes depressions on crowns as ponds or fields, and implies that this may have been one of their functions. According to traditional history, a basin in Ngardmau's Ngkisikikl era ReDioll crown holds a continuously producing taro patch while the

place names of a few basined crowns (e.g., Meklechel a Beab 'taro swamp of the rats') suggest horticulture.

Despite erosion and deliberate infilling disguising the actual number of basins in crowns, they are identifiable in over a third of Babeldaob's crowns. Although some are waterlogged with swamp taxa growing in the rich organic soil (e.g., Uluang, Disechir ar Turang), the floor of most crown basins is dry except during extended periods of rain (e.g., Oratelruul, Ngemeduu, Ngermekii). Gleyed and ironstone deposits in the Ngemeduu (Phear 2007) and Ngedelchong basins show that they once held standing water. Excavations in the shallow basin capping a Ngaraard crown (Phear 2007:52–65) did not detect evidence of horticulture although the acidic soils preclude identification of cultivars or special soil amendments. The pollen assemblage (Cat. No. 462) detected in the gleyed surface of the basin on the Ngedelchong crown is waiting analysis.

Small ceremonial or elite owned cultivation basins are not only found on crown summits. Still elevated above the surrounding landscape, the terraced terrain at the foot of the Sisngembang outcrop contains at least one small basin. Its size and location suggests a specialized function. Larger basins in more easily accessible locations (e.g., Tabelmeduu, Site NA-4b), although not on crowns, are possibly communal cultivation plots or were reserved to produce food for a group of high-status individuals. The extent of these inland large basins is not known. They may have supported a substantially sized pondfield cultivation system that supplied both elite and commoner with agricultural products.

A basin was built on construction fill in the Ngedelchong crown at about 2120–1900 calBP. This is concurrent with an unidentified crown activity occurring adjacent to the basin that required multiple construction sequences. The duration of basin use is indeterminable. It was intentionally infilled at least 300 years ago and probably much earlier.

On the Sisngembang outcrop crown, soils were stripped to bedrock by at least 1740–1560 calBP to accommodate a shallow feature of unclear form containing dark moist sediment. This is likely a basin or similarly functioning feature. By ca. 1350–1150 calBP a basin containing

these same sediments and ringed with a carefully fashioned stone retaining wall covered a third of Sisngebang's summit (Figure 45). Concurrent with activity in the basin was the placement of a pottery cache of unique decorated, painted and footed vessels on the summit's now elevated central terrace. Although no human skeletal material was associated with the cache, it may be related to a burial or a ritual event tied to the basin. Partial infilling of the basin identifies that it was no longer in use by at least 1100 calBP.

Many crown summits supporting basins are in prominent locations offering expansive views over lagoon, bay or river valleys as well as potentially cultivated step-terraces, swales and gullies. Both the Sisngebang and Ngedelchong crowns overlook the terraced fields below and were easily seen by the surrounding population and approaching visitors.

Placement of cultivation basins on the restricted space of high crowns is a strong indicator that ritual and ceremony were intertwined with the economic production system. This may be related to the substantial effort required to produce dryland crops or may demonstrate a vulnerability to environmental perturbations. Priests or high-ranking individuals could have used the cultivation plots in ceremonial events, perhaps as an expression of gratitude or a petition to the gods, or for fertility rites associated with rain. The limited quantity of cultigens, medicinal plants or ornamentals produced could have been dedicated to ceremonial or ritual events or for consumption or use by the upper class. Produce reserved for consumption by the elite reinforces or legitimizes their status in society. Limited access to the cultivation plots by the public and its high visibility to the general population identify emerging elites.

9.4 Ritual Construction

As at Cahokia's traditional earth structures (Pauketat 2000; Pauketat and Alt 2005), there is growing evidence that in some instances the act of constructing Babeldaob's earthworks was associated with ritual or ceremony (Liston 2008). Ritual is identified by the whole pots, pottery caches and other significant objects that were deliberately inserted beneath and in earthwork fill simultaneous with the construction event. Highly suggestive of ritual, the nature of the activity is not clear and could be associated with the act of earthwork construction, with

the sociopolitical event precipitating the construction or as a ceremonial event in and of itself. Traditional history equates some earthwork construction, such as Roismelech (Hijikata 1996:76–78), is linked to the gods.

Ritual construction is found at the ceremonial centre or elite complex on Tabelmeduu. A pair of complete vessels, one upturned over the other, was placed in the basal construction fill of a Tabelmeduu earth platform before being capped by a small rock mound and additional fill material (Figure 70; Liston 2008:41). Within the platform tier are numerous intentionally placed whole and partial pots while in the saprolite beneath, are pottery caches and an elongated stone in a deep rock-filled pit. Densely distributed among and under the ridgeline's other earth platforms are ceramic caches (Tuggle 2011). Clearly not rubbish or pot breaks, the caches are associated with earthwork construction, suggesting their ritual interment.

The number of ceramic caches and primary vessels exposed in a single excavation trench through an earth platform on Toimeduu's southwest slope led Tuggle (2011:168) to speculate, "if this is a representative sample of the entire feature, then about 130 primary vessels were placed in the earth platform." Dated to about 2000 calBP, the stratigraphic column contained only construction matrices, and no evidence of occupation. Tuggle (2011:168) noted that:

there is no obvious practical purpose for the construction of the fill layers on the slope. This does not significantly expand the surface area of the earth platform. It is possible that slope construction was specifically to serve as a means to bury the ceramic caches.

At Roismelech, an altar dated to ca. 2000–1820 calBP lies under a deep, high step-terrace adjacent to a ring-ditch and crown (Figure 64). The construction sequence involved preparing the low coral-edged altar, capping it with a bed of broken sherds to support three unique whole pots, covering it with an impermeable clay layer and finally adding a 3.8 m thick layer of fill. Constructed from Babeldaob clays, the form of all three vessels is unknown elsewhere in Palau. Although considered unlikely, the alter could be a burial marker and have no relationship to the ensuing earthwork construction.

The whole pots and pot caches are directly linked to earthwork construction and identify a ceremonial or ritual aspect to the act of building earthworks. Ritual is identified at the beginning of the process (at the base of individual features) and may have occurred throughout the construction period. In some locations (e.g., Tabelmeduu) whole pots are distributed both under and throughout the earth fill.

Given the arduous and carefully engineered building process, the vessels may be offerings to the gods of construction to petition for the successful building and long-term stability of the massive earth structure. Or the offerings may be in honour of the elite who was financing construction of their tomb, house site or political arena. Finally, the caches and vessels and the accompanying construction event could be a marker memorializing a significant event such as the investiture of a new chief, a war victory or a formal alliance.

The effort required to construct such huge earthworks ensured a large portion of the population took part in the building process. Because in at least some cases the ritual activity continues throughout the course of construction, the rites were viewed by or participated in by the gathered workforce. Just as in the act of building earthworks, these ceremonial events could bond the community to shape group identity (Phear's 2007:133–137). Ritualization of the construction process imparts a meaning to the earthwork beyond its eventual practical use. Ultimately it identifies the monumental structures as a significant component of the landscape and a symbol of the larger sociopolitical unit, regardless of whether on the community or the polity scale.

9.5 Burial Practices

Investigations of the evolution of complexity often focus on transformations in mortuary behaviour that can define groups, property rights and status differences (Saxe 1970; Peebles and Kus 1977; Tainter 1978; Seikel 2011). Distinctions in rank of the individual interred are identified in the relative size or elaboration of the tomb or the display of personal wealth in the accompanying burial furniture (Earle 1997). Structured burials in monumental features with

plentiful grave goods can mark elite individuals and network strategies while communal graveyards may identify corporate behaviours.

Since the 1920s, when the Japanese administration mandated burial of Babeldaob's dead in cemeteries rather than clan burial platforms (*odesongel*), many village graveyards are located on ancient modified ridges or crowns.²⁰ Long before their use as historic cemeteries, traditional history and archaeological investigations indicate earthworks were used for gravesites. Parmentier (1981:115, 240, 250) was told that terraced or hillside graves are named *debull*, a word adapted to also refer to contemporary individual stone or concrete grave markers.

Oral history relates that Chelebuul (poverty), a descendant of the giant clam Latmikaik, is buried on Toker crown in Oreor (Krämer 1926:3). The giant Ngalekdmeuang was laid to rest in Ngchesar's Ngerngesang terraces after Melekeok villager's poisoned him so that he would stop consuming their food supplies (Hijikata 1996:140; Tellei 1998:243). Parmentier (1981:228–230) documents a version of this story where Chuab's children, after burning the giant to death, wander Babeldaob eating all the fruits and leaves off the trees and leaving the villagers to starve. They are poisoned and buried in terraced hills in Ngaremlengui and Ngchesar named Debellelangalekdmeoang (Debellir ar Ngalektmeuang 'grave of the cursed children').

In one version of the Milad cycle of stories, the mother of Dilmalk's (one of Milad's reincarnations) is buried on Omsangel, a crown earthwork in Airai (Parmentier 1987:156; Liston 2007b). An ancient high chief of Ngerkeai village is buried standing up in the knoll of the Oltangelmad crown, the same crown currently used as a public cemetery (Olsudong et al. 1998:118). The crown on Medong, a terrace system in Ollei, supports a coral platform in which Palau's only stone sarcophagus was partly buried (Osborne 1979:203–212; Hijikata 1995:130–137). The coffin contained the incomplete skeletal remains of an adult (possibly

²⁰ Some of the historic graveyards located on crowns include Techobei (Melekeok), Chisau (Ngaremlengui), Bisecherad (Ngarchelong), Ngertacherudel (Airai) and Oltangelmad (Aimeliik) while ridgeline cemeteries are found at Terull (Ngaraard), and in ridges whose names are not known in Ngkeklaui (Ngaraard) and Ngiwal.

female) and the single bone of a child. Hijikata (1995:136) recounts an unconfirmed story that the tomb belongs to a Ngeruangel chief (Delengeli Ruangel) who led the survivors to Babeldaob when the island sank.

Due to Babeldaob's acidic soils rapidly deteriorating bone, human skeletal elements are very rarely encountered in archaeological excavations. Although surface indicators of upland gravesites are poorly defined, earthwork burials are identified by burial pits capped with clay, sea sponge mats and rock features and their occasional association with burial goods, most often pottery vessels. Interments are found in small structured communal burial sets on step-terraces and crowns.

The practice of terraces serving mortuary functions began by at least 2000 calBP as evidenced by the structured burial set unearthed from deep in an upper tier of the deep, step-terrace complex of Rois (Tuggle 2007:313–345). The three definite and six possible individual graves all have the same orientation and were interred from the same surface, but they were probably placed in two burial events. As part of the burial complex, three whole vessels were placed in pits excavated from the same surface as that of the burials. A clay cap, dated to ca. 1700 calBP, intentionally placed above the burial pits is likely representative of a ceremonial closing of the burial area (Tuggle 2007:368).

About 200 north on the same ridge slope are the Mesesuiuil earthworks where it appears human burials were placed in a small habitation complex with a combined calibrated date range of 2010–1610 BP (Liston and Rieth 2011). The interments are identified by east-west orientated pits some capped with small pavings. The nearby step-terraced slope of the Toimeduu triple crown complex, radiometrically dated to roughly 1950–1700 calBP, unearthed a copious amount of whole pots that are interpreted as grave goods (Liston and Rieth 2011:351–369). Two whole pots rested above, and three spherical basalt cobbles were carefully placed next to, a square paving too small to be associated with a structure. Though no certain burial pits or human skeletal material was encountered, the lack of household midden and the surround landscape context strongly suggest a graveyard.

With limited archaeological evidence, it appears that it is only in the Late Phase (ca. 1500–1100 calBP) of the Earthwork Era and in the Transitional Era (ca. 1100–700 calBP) that interments are placed in especially constructed knobs and berms on previously existing crowns. Ngaraard's immense Roisingang crown complex (Type IIIb) produced human interments in a 2.5 m high, 4.0 m wide and 5.0 m long earth knob placed on the previously built crown complex (Tuggle 2011:218–227). The knob covers one and possibly two pits that were once faced (or capped) with basalt and coral cobbles and slabs. Tuggle (2011) interprets the knob as probably marking the burial of high-ranking individual(s) between 1530–1060 calBP.

Equally as prominent as the Roisingang crown is the Sisngebang outcrop crown overlooking the narrow entrance from the lagoon into Ngeremeduu Bay (Figure 38). Human burials, identifiable by burial pits and decomposed teeth, were unearthed in a berm on the outcrop's modified summit. The red, or red-stained, matrix underlying one individual indicates the burial was accompanied by ritual. Disturbance to the whole pots placed as burial furniture identifies the summit acted as a graveyard over a period of time rather than solely for a single interment. The berm burials, occurring by at least 1180–980 calBP, may have been the last structured activity on the crown that was constructed over 600 years earlier.

Structured burial sets with burial furniture in ridgeline settings began by 2000 calBP and, at least in the north end of the Ngaraard earthwork district, became a regular occurrence by 1800 calBP. The earlier terrace burials may have been communal although possibly restricted to high-status individuals of particular clans. Current archaeological evidence indicates that it is not until the Late Phase of the Earthwork Era that individuals, likely of the highest sociopolitical status, are buried in crown summits. As crowns contain more than one individual, they may have held the elite of a specific area or members of a single high-status clan. These crowns are in very noticeable locations, clearly visible from the lagoon and across large portions of the island. Their interment in such prominent crowns serves as a symbolic representation of individual power and prestige.

9.6 Summary

The ritual aspect of some of Babeldaob's earth structures is identified by a combination of the prominence of partitioned, difficult to access and confined ceremonial areas; intentionally hidden prestigious, unique ceramic vessels and caches; the paucity of domestic midden in contrast to the quantity and variety of atypical and specialized features; and an association with mortuary activity.

The process of constructing at least some earthworks has a ritual or ceremonial significance although the nature of this relationship is unclear and could relate to the actual construction event, the occasion that led to building the structure or its intended function. The summits of some monumental crowns served as ritual cultivation areas and had a funerary context while some ridgelines were reserved for ceremonial or elite activity areas. Many of the earthworks display several of these ritual behaviours that may reflect functional changes through its long period of use.

All earthworks may contain some element of ritual that is associated with their creation while specific structures may have been instilled with a highly ritualized or sacred meaning from their inception. As stages for ritual performances the earthworks were inscribed with cultural meaning. They became enduring symbols of spiritual and ideological power to sanction religious authority and the emerging elite. In this way, earthworks promoted social cohesion by renewing ancestral and traditional connections and bonding the community to the land, at the same time they were powerful conduits for institutionalizing belief systems. The act, practice or formalization of the ritual behaviour transformed through time dependant on changing leadership strategies.

The prevalence of ritual cultivation in specially constructed basins on crown summits, beginning about 2000 years ago, suggests this was a common Earthwork Era ritual performance. Ceremonial cultivation identifies the political economy of food production is within the scope of the emerging elite or priestly class. This union of the political economy with formal ritual behaviour is also found in Hawai'i. Mauna Kea's first shrines are

contemporaneous with the rise in quarrying activity that produced the prestigious basalt adzes (McCoy et al. 2009). Additionally, the matching temporal shifts in the placement of *heiau* (temples) and territorial boundaries are associated with agricultural production (McCoy et al. 2011).

Ritual behaviour is identified in the archaeological record as appearing almost simultaneous with the creation of a monumental landscape. Ritual practices transformed the landscape into a space that provides a sense of community attachment and cohesion. The extent and prominence of this landscape that the population constructed, worked on and lived in transfers the dominant ideology expressed by the ritual architecture to the population and legitimizes the status of the elite. The degree to which the religious specialists and the political elite merged is not known although the two classes may have always been embedded in one another. Control of specialized knowledge or rituals that were held on the monumental architecture also serves to create and legitimize status, authority and power.

As a shared ritual landscape with duplicated architectural forms and ceremonial behaviours across Babeldaob's earthwork districts, the meanings and symbolic associations held in the built landscape can be read and internalized by the entire region. This suggests these ritual behaviours were incorporated into the competitive political economic strategies chosen by the emerging elite to politicize the landscape. Territorial boundary definition and defensive behaviours embodied in Babeldaob's earthworks are discussed in the following chapter.

10.0 POLITICIZING THE LANDSCAPE

Populations are attached to territorial units not just through consent but also by memories and traditions (Smith 2003). Rock art, place names and oral traditions socialize the landscape. These practices and monuments or social space, as stages for ritual, ceremonial or other important events, bond the community to the land by giving significance to places (Kolb 1994). These same behaviours solidify social relationships in relation to space to implant a feeling of community ownership or property rights to the land. Land units become simultaneously socially and politically defined so that the landscape itself is politicized (Smith 2003). These attachments can be enhanced and manipulated by the emerging elite through attaching a value to the land, instilling it with the dominant ideology, land tenure systems and warfare.

As an area of bounded space representing a cultural, social or natural unit claimed or occupied by a person or group, territory is a geographical expression of power (Sack 1986:5). Defending and maintaining control over a territory and the resources and material symbols it contains becomes a powerful geographic leadership strategy (Sack 1986; Johnson and Earle 1987). The ability of the elite to coerce, seize or defend resources through military power can be essential in sociopolitical development and political centralization (Carneiro 1970; Ferguson 1997; Earle 1978, 1997; Haas 1990; 2007).

Military power encompasses not only full-scale warfare but also raids, attacks and other forms of conflict. The goals behind military power vary widely ranging from the acquisition of resources and the aggregation of land units into larger territories through defence, public posturing and sealing of alliances (Haas 1990; Allen 1994; Keeley 1996; Ferguson 1997). Underlying these objectives are the interconnected variables of demographics, resource scarcity and surplus and social motivations of status rivalry, revenge and succession. Despite population pressure in circumscribed environments being a component of conflict (Carneiro 1970), Keeley (1996:118–119) suggests there is no direct correlation between the two.

Kolb (2011:158) identifies the “intrinsically linked” variables of productive circumscription and social competition as the motivating factors behind the emergence and use of island monumentality. The more environmentally or socially circumscribed an island is the greater the intensity of corporate competition and the more monuments are constructed. He states:

As social inequality and economic intensification increased over time, island communities struggled with ways to maintain their collective unity in the face of emerging elites. These monuments represent a variety of expressions for economically and ideologically enhancing long-term authority. [Kolb 2011:159]

The intensity and frequency of warfare increases during difficult economic conditions when conflict results from an attempt to expand territory to acquire more resources (Keeley 1996:127–141). Evolutionary ecology models for the establishment of territoriality consider the cost/benefit strategies of competitive and cooperative behaviour (Boone 1992; Aswani and Graves 1998; Field 1998). Conflict between groups is favoured in less productive areas as it enables pooling resources to buffer against environmental perturbations. Regions with stable productivity, populations who have reached productive capacity or those experiencing poor economic conditions might expend less energy obtaining resources through warfare or tribute than in increasing local production. Integrating subsistence production into a cohesive political territory reduces the risk of losing the food supply (Allen 2004).

Traditionally, many land tenure systems were based on corporate kin groups. Access to resources were limited to members of the community and regulated by informal and formal customs. Land units would originate along productive lands or shorelines and might be separated by buffer zones of low population and marginal productivity. Over time, people’s interactions with the land ascribe meaning to it so that their relationship to a space is materialized (DeMarrais et al 1996). Ancestral ties with communal graveyards and individual burial monuments mark the landscape with lineage property rights (Saxe 1970; Binford 1971; Renfrew 1973; Earle 1991b).

The transition to bounded political units or land tenure is often correlated with population growth, agricultural intensification and the creation of landesque capital that increased the value of the land (Boserup 1965; Netting 1993). Land tenure systems arise as emerging elites in staple finance economies attempt to gain control of production and distribution of the terrestrial and marine subsistence base. Although the elite may own and manage the land, portions are allocated to individuals or kin groups who cultivate the fields for their own subsistence needs in exchange for supplying surplus and labour to the elite (Earle 1997; Kolb 1997).

In this political economic approach, the acquisition of territory is a means of financing elite institutions and status competition (Earle 1991b). By owning or managing property, political leaders can regulate access to arable land, fishing grounds and food collection areas, direct the production of surplus or extract tribute (Bintliff 1999; Earle 1997, 2000). D'Altroy and Earle (1985:204) identify political organizations based on landesque capital and staple finance as "remarkably stable" when compared with wealth financed economies. In part, this stability rests in the ideological tie of the population to the land.

Land tenure systems impose structure on the landscape to identify sociopolitical organization (Kolb 1994). Strategies are chosen to institute and materialize land claims and rights of access. Space is delineated through natural features or constructed boundary markers, forts or villages along the perimeter, built landscapes and buffer zones of little cultural activity (Kolb 1997; Earle 2000). Differences in spatial organization or relative size, form or style of cultural properties in land units can correspond to the hierarchy of institutionalized land ownership. Transformations in the cultural landscape that denote boundaries and ownership should track temporal changes in land tenure systems (Kolb 1997).

Political territorial units at the district level are found throughout Oceania. District boundaries and land ownership are commonly identified by monumental and religious structures (Graves and Sweeney 1993; Ladefoged and Graves 2006) such as *moai* in Rapa Nui (Stevenson 2002; Shepardson 2005), *latte* structures in the Mariana Islands (Hunter-Anderson

1989:45) and shrines and other ritual architecture in Hawai'i (Ladefoged and Graves 2006). The hierarchical rank of the associated polity is identified in the relative spatial distribution and size of these monuments (Kirch 1990a).

The multiple facets of military power and its expression in earthwork structures did not escape Babeldaob's Earthwork Era leaders. In addition to the more mundane practical functions as foundations of cultivated fields, habitations and activity areas, earthworks were employed in multiple and simultaneous symbolic, ritual and defensive roles all of which enforced and promoted the dominate ideology. As a component of military power, earth structures were integral to the fused aspects of land tenure, symbolic power and warfare which in turn are linked to the political economy. The following section looks at the mechanisms involved in these developments.

10.1 Political Economy

Emerging elites are financed by and establish their authority from gaining power over the production and distribution of material resources and labour. Land ownership as a form of wealth plays a significant role in the development of the political economy and the evolution of institutionalized inequality. The forcible control of the land that produces the staples on which the political economy is based links military, ideological and economic power sources (Earle 1997:110).

Alternative types of economic control are based on various proportions of wealth, staple and ritual finance (D'Altroy and Earle 1985; Wells 2006; Wells and McAnany 2008; Rice 2009). Identifying the form of Earthwork Era political economy is a matter of distinguishing which of these types of economic control were available to generate wealth and power and how these valuables might be controlled and manipulated in favour of the emerging elite.

Trade Goods and Long-Distance Exchange

Inter-island trade of prestige goods and staple resources that was advantageous and often detrimental to the social development of many Oceanic societies (Kirch 1991; Irwin 1994;

Weisler 1997) is not documented in Palau's Earthwork Era (e.g., Clark 2005). This may in part be due to the acid soils and landscape transformations on Babeldaob destroying or covering those perishable goods that played a significant role in political economic strategies. Palauans did not engage in long-distance navigation at Western contact. It is possible that Palau had little interaction with distant cultures from early in the cultural sequence. Additional research is needed to identify when Indo-Pacific trade beads began to circulate in Palau, an activity that may be linked to the Yapese arriving on the archipelago to quarry for stone money in the middle of the second millennium (Ritzenthaler 1954).

As evidenced by the large amounts of pottery vessels, and to a lesser extent basalt tools, throughout Palau, there was local trade between Babeldaob and the smaller outlying islands that did not have clay or stone sources. Initially, single pots could have been transported by individuals for their personal use. When permanent communities were established on the smaller islands, by at least the middle of the Earthwork Era, the exchange of pottery vessels likely involved large-scale barter. An inter-island trade network through kin-based systems or political alliances may have been established that involved the exchange of Babeldaob's ceramic vessels, stone tools and produce for particular marine foods and shell tools from the limestone islands.

Despite the abundance of marine shell, the durability and quality of basalt is preferred over the shatter prone shell for adze production (Haslam and Liston 2008). The scarcity of raw material sources of the quality needed for lithic assemblages suggests that quarries may have been held in high regard. As a limited resource, stone implements, particularly adzes, might have been a prestige item. Those encountered in Babeldaob's archaeological deposits do not reveal a pattern suggesting they were highly valued. Stone adzes have not been unearthed as burial furniture, in caches and are not restricted to particular site types; rather, adzes are most often found in contexts suggesting they were discarded or lost.

Clay sources are liberally scattered throughout Babeldaob although access to the purest clay procurement areas may have been strictly controlled by the elite. Despite the probability

of variations in form, technology, style or decorations in Babeldaob's pottery, none are immediately apparent to identify intra-Babeldaob trade in ceramic vessels. Given the immense quantity of sherds in the archaeological deposits, it is likely that the production of at least utilitarian wares was not restricted to specific areas and perhaps only speciality wares and those vessels destined for the outer islands were traded. Special or unique decoration and form or a finer craftsmanship is found in the whole vessels and pottery caches at Sisngembang, Roismelech and Tabelmeduu. The rarity of these vessel types and their ritual deposition indicates that they were produced specifically as ceremonial ware and were reserved for the sole use of certain members of the population and for ritual events.

Staple Finance

Without evidence of exotic trade goods or abundant artefactual assemblages reflecting prestige items, the most valuable item in the Earthwork Era archaeological record is the earthworks. Landesque capital came to represent generations of labour invested in creating and maintaining step-terrace systems and retaining soil fertility to provide food security and surplus goods. The highly skilled engineering and the considerable quantity of materials and labour force dedicated to construction and upkeep of the associated ritual, occupational and defensive earth architecture further increased the economic value of the built landscape. Building earthworks created assets.

The subsistence goods produced on the step-terraces and basins and the captured marine resources appear to be the primary revenue for financing the activities and political economic strategies of the emerging elite. The elite not only invested in the infrastructure of the economic production system but in the entire engineered landscape. Power was created and legitimized by this "political currency" that identified control over engineering expertise, land and labour (D'Altroy and Earle 1985:203). The primary form of displaying wealth was the highly visible earthwork structures. As wealth, the structures gained their importance by symbolizing the status, legitimacy and power of the polity and its rulers and their explicit rights to the staple goods produced.

Power and prestige may have also been gained through ritual finance and authoritative resources (Wells 2006; Rice 2009). This includes ritual performance and other forms of esoteric knowledge that shape or materialize worldview and belief systems. Control of the production, distribution and safekeeping of ideology is aimed towards legitimizing and strengthening the social and political interests underlying the political economy (Lindstrom 1984; Rice 2009).

As in many Oceanic societies, in Palau the ideology encoded in myths, symbols and traditional narratives is an intangible form of wealth (Nero 1987; Parmentier 1987). In Palau's highly structured hierarchical society, knowledge ". . . is both a source of power and a commodity. It is a bargaining chip in cultural negotiations, with rules that limit access" (Tellei et al. 2005:14). This cultural knowledge of myths, symbols, social relations and ritual ties the community to one another and the larger island society to provide identity, well-being and continuity. Although unidentifiable in the archaeological record, authoritative resources were probably a significant source of power that was strictly controlled by leaders and priests.

In traditional and contemporary Palau, knowledge of specific skills is a power source with expertise restricted to select individuals or groups. Individuals highly skilled in woodcarving, construction of chiefly meeting halls and building stonework, among other talents are given the title of 'Master.' With the proficiency and technological specialization needed to construct earthworks in Babeldaob's environment, it is probable that earthwork engineers were bestowed a high rank in society. Technological advancement in itself is viewed by Burley (1998) as correlated with emerging complexity in the same way craft specialization is. Construction of both immense and elaborate earth structures can then signify a valuable resource.

10.2 Competition and Warfare

Despite the form of warfare and defence varying with social complexity, leadership strategies and population density, conflict and forms of warfare between social groups is

argued to be virtually a cultural universal (Keeley 1996; Haas 2007). In pre-state societies, inter-societal conflict commonly takes the form of “deadly raids, ambushes, and surprise attacks on settlements . . . [which is] war reduced to its essentials: killing enemies with a minimum of risk, denying them the means of life via vandalism and theft. . .” (Keeley 1996:174–175). The importance of cooperation and competition as a variable in Palau’s social evolution was identified by Gumerman (1986) although at the time there was insufficient evidence to elaborate on political development.

Direct evidence for actual conflict is rare; however, manifestations of warfare may be quite common. Most groups with permanent settlements have fortifications, frequently manifested as simple defensive features. More often “fortifications are the costliest and largest-scale pieces of preindustrial technology” (Keeley 1996:55). This investment in durable fortifications is worthwhile due to their symbolic as well as military importance (Smith 2003). In addition to fortifications, other material evidence for conflict, warfare or territoriality includes places of refuge, buffer zones, fortified settlements or residences, formalized regional settlement patterns, boundary markers, ritual structures dedicated to war, weapons and human burials with evidence of trauma (Keeley 1996:57; Earle 1997; Kolb and Dixon 2002:515).

Recent archaeological investigations allowed for Liston and Tuggle (2001, 2006) to propose a model of changing warfare based on symbolic posturing of rank and authority which identified earthworks as an integral component of Earthwork Era conflict, warfare and territoriality. The pattern, morphology and size of earthworks and the few references in traditional narratives associating structures with defence are the only evidence of competition and conflict in the Earthwork Era. Human burials showing trauma are not encountered in Babeldaob’s acidic soils and military weapons have not been identified in Earthwork Era deposits.

10.2.1 Warfare in Traditional History

Ethnographically, warfare is an institutionalized component of traditional Palauan culture (McKnight 1960). Although relating to a later time, but with possible application to the

Earthwork Era, warfare “dominates historical traditions as recorded in stories, chants, songs, proverbial expressions and pictorial carvings” (Parmentier 1987:90). These accounts record incessant and structured warfare, as shifting, unstable alliances of villages, districts and federations changed composition, organization and rank. An extremely rigid, ideal kin-based hierarchical social structure overlying a fluid system of internal change driven by competition is critical to understanding traditional Palauan warfare (Force 1960; McKnight 1960; McCutcheon 1981). A nineteenth century German ethnohistoric account summarized the role of war in Palauan culture (Kubary 1873:32):

War has a different sense here than it has in other places. It is a political institution, a traditional custom, and a means of raising tribute.

In Palau, warfare was a dominant means to establish and maintain the power and associated prestige that was the aspiration of each chief, clan or political unit. Through conquest, the victor could acquire new territory, destroy a village and establish tribute relationships, all steps to becoming more powerful.

The references to land acquisition and population resettlement in the ethnohistoric records do not identify increasing complexity, centralization or integration (Vidich 1949; Parmentier 1987:64–65). Rather, a number of levelling mechanisms were at work to dilute power. Power was offset by the structure of ranked kin groups, the ideology and practice of competition that allowed for changes in ranked position among kin groups and villages and by the fact that it was prestige through symbolic recognition that was ultimately more important than physical domination.

Palau’s oral traditions relate a few instances of earthwork construction for defensive purposes. A reference to *klaidebangel* (‘hole dug as a trap’, a ditch) is found in the story of the battle between two Ngchesar villages (Tellei et al. 2005:70):

klaidebangel were dug and lined with spears with their points pointing up, and then covered. On the day of the battle, the villagers of Ngerkesou baited the men of Ngemingel by holding a festive dance at the other side of the trenches. The men of Ngemingel were offended by this behavior since they felt that an inferior village should not hold a festive dance in their sight. The men of the village rushed to attack them whereupon some of them fell into the trenches and were killed.

Palauan children still play the game '*klaidebangel*', in which, after digging a shallow hole in the beach and disguising it with twigs and leaves, they contrive to have someone fall into it through cunning and devious means (Basilius 2002:150).

One narrative tells how trench defensive features originated. A demi-god from Koror is said to have assisted Melekeok in destroying its enemy, Oliuch, by directing the war party to construct wide, deep ditches perpendicular to terrace tiers (*chomedoiluach*, 'foot-catchers') to hinder the advance of their advisories (Lucking 1984:29–30).

The ditches ringing some levelled hilltops and crowns are also described as defensive in traditional history. Ngerbeluud villagers dug the deep ditch circling Ngaraard's Obichang crown to trap the oppressive Ngeriteet warriors (Olsudong et al. 1999:158). At the ring-ditch around Ngchesar's Roisersuul crown:

warriors from Ngeremlengui, whooping their war cries, ran forward to intercept the warriors from Ngersuul and immediately fell into the trench. They were set upon by the warriors of Ngersuul and were beaten or speared to death (Basilius 2002:149–150).

Oral histories refer to the use of prominent hilltops, not all of which are shaped into crown earthworks, as signal towers (*klekat*) (Krämer 1929:95; Parmentier 1987:272–273; Tellei et al. 2005:72, 81). The allied villages of Oikull and Melekeok warned one another of impending attacks via smoke signals sent from high crowns. Ngaremlengui signalled Oreor of approaching adversaries by building a fire on top of Etiruir. Ollei's Eleos crown and Ngaremlengui's Ngermengot crown also functioned as *klekat* (Olsudong et al. 1998:102).

Hills strategically located around agricultural fields, villages and district borders are said to have served as sentry posts. Sentries stationed on outposts along the Ngchesar Trail—crossing the terraced hills of Demailei, Roisersuul, Bluurois and parts of Mesial—protected Ngersuul village by warning of imminent danger with signal fires (Basilius 2002:149).

10.2.2 Palauan Defensive Features

Babeldaob's crown and ditch complexes are commonly attributed to defensive functions (Butler 1984; Lucking 1984; Masse et al. 1984). Essentially, all Palau's earthworks, as

individual features and a unit, are integral practical and symbolic components of conflict, warfare and territoriality in the Earthwork Era. In a defensive capacity earthworks functioned as barriers, signal towers, sentry posts and ideological symbols. As territorial markers they legitimized corporate claims of land and other resources. Even as the uses of earth structures changed through time most functioned on several different levels, only one of which is defensive. For example, some ditch features may have channelled water into agricultural fields and blocked access into an area. They may also have served as places of refuge and fortified residences. These defensive components operate relative to both between and within earthwork districts.

Multiple ditches (*klaidebangel*) are strategically placed to bisect the ancient trail systems that crisscross Babeldaob on flattened ridgelines, elevated paths and tracks eroded below the surrounding topography by centuries of use (Liston et al. 2002:44; Olsudong et al. 2008). The lengthy Ngchesar trail is dissected by at least seven *klaidebangel*. In Type IIIa complexes, transverse ditches are found at the base of each of a series of levelled areas on the ridge leading up to a crown with the deepest ditch located on either side of the hilltop. Ring-ditches enclose the base of some crowns to effectively isolate the summit from the surrounding landscape.

In situations lacking the element of surprise, earth dug during ditch construction formed an embankment that served to deepen the ditch. Mounded berms without associated ditches that cross some ridgelines may be Japanese Era structures or, less likely, could be traditional defensive features. These ditches do not appear to have functioned as a moat, as evidence of standing water has only been encountered in a single ditch (Ngebars). A *Pterocarpus indicus* post, a component of a palisade or possibly a lethal pointed stick, radiocarbon dated to 1420–1290 calBP, was revealed in the inner margin of the ring-ditch around Ngatpang's Ngebars crown (Liston 2011b). It is likely palisades were positioned in many ring-ditches to impede access to the summit.

When cutting ridges, these deep ditches impede access into populated areas. By sectioning pieces of land, ditches could create confined ritual or social space rather than purely blocky passage. According to Phear (2007:135), ditches

were a means of reinforcing the importance of the place, a way of distinguishing between different conceptual levels of social visibility. . . . The ditches were visible signifiers that told people that access was not for all; they created and reinforced social boundaries. [Phear 2007:285]

The social space being delineated, generally crown summits or levelled areas leading to crowns, is small enough that it could only hold a very limited number of people, likely high-status individuals. Hence, when sectioning off crowns, ditches block entrance onto structures dedicated to high-status events, elite habitation or activity areas or possibly places of refuge (Osborne 1966; Lucking 1984; Liston 2011a).

As crown summits are too small to shelter a substantial number of people, they are not strictly 'hillforts.' In the main, the sheer angle and height of most crowns, their commanding view over great expanses of the island and lagoon, their strategic placement around the perimeter and within earthwork clusters and their association with palisades and ring-ditches implies defensive roles, in addition to their other functions (Osborne 1966; Liston 2007a; Liston and Tuggle 2006). These defensive functions could include use as a sentry post, lookout position and signal tower as well as a fortified stage for ritual, burial or elite habitation. Often crowns also contained a symbolic significance related to power and ownership to serve as territorial boundary markers and elite posturing.

With a clear line of sight between them, many crowns could serve as sentry posts for guarding the immediate area from an encroaching enemy, or for alerting distant allies with smoke signal communications. Within the district, guards on crowns could oversee the population's resource production and other activities. On the seaward edge of the polity, retainers stationed on high earthworks might have monitored fishing and gathering activities on the lagoon and reef. This ensured elite control of the subsistence base as well as reminding the population of their corporate work responsibilities, their subordinate role and elite hegemony. Surveillance is an effective mechanism to both enforce and express the power of

the elite (Simpson 2009). Like the *moai* looking inward over Rapa Nui, the crowns could control territory and re-enforce chiefly rule (Martinsson-Wallin 1994; Van Tilburg 1994).

Fortified refuges serving as temporary protection for members of the society occur in most mid-level societies (Keeley 1996). Places of refuge (or asylum) play a prominent part in ethnographic accounts of Palauan warfare and are understood by all parties to be havens from attack. Some crowns and the larger summits of levelled hilltops may be places of refuge when not being used in other capacities. Low crowns in step-terrace systems could have allowed small work groups to take refuge against raiding parties. Alternatively, the summit may be a location the enemy might want to capture for symbolic reasons.

Another apparent defensive component of most earthwork complexes is the difficulty accessing their level surfaces. Intentionally cut almost vertical slopes rise high above the surrounding terrain to often leave only one, if any, practical mode of entry (Figure 2). Ladders descending the sides could be quickly pulled up in the event of attack. The few standard entrances onto large complexes could be easily guarded. Step-terraces with high risers also served a defensive function by blocking access into or out of areas.

10.3 Ideological Symbols

Symbolic posturing is found in competitive situations as rival leaders contend for greater power. Referring to fortifications, but equally applicable to monumental structures or other material manifestations of status, Keeley (1996:57) states:

At the most prosaic level, they symbolize their owner's military sophistication, military power, and determination to hold occupied territory. More abstractly, they demarcate the boundary between defenders and attackers. . . In chiefdoms and states, fortifications symbolize the importance and manifest the power of a leader.

The construction of earth structures well beyond what is required to accomplish any practical function suggests that they functioned as symbols. Along with its monumental size, the prominent placement of crowns on the landscape suggests that their symbolic significance was particularly important to Earthwork Era society (Liston and Tuggle 2001, 2006; Wickler 2002; Liston 2007a:342).

The symbolism was emphasized by adept manipulation of the natural topography to increase the visual impact of the structures. This created the illusion of even more massive constructions whose most impressive silhouettes are viewed by those across the lagoon or down the island. In some cases, an enormous amount of coral and basalt boulders were deliberately placed on the sides of earth structures that are more advantageously viewed from the coast and lagoon rather than from inside the district. A fair number of prominent crowns are obviously not meant to be distinctive to the immediately adjacent population despite their presence remaining obvious. These structures are a permanent and dramatic symbol of the strength of the elite and district that is meant to be seen by other polities.

Liston and Tuggle (2006:65) propose that the “major defensive element of the Palauan terrace complexes was the appearance of power.” Earthworks symbolized the ability of the elite or polity to mobilize and finance the enormous investment dedicated to their construction. They mirrored the associated polity’s prestige level as they defined its political boundaries and created defensible terrain. Rival factions in the Earthwork Era may have relied on this competitive posturing of political and economic power by the elite rather than bloodshed to determine and legitimize status and authority.

Symbolism is also acquired through the memories attached to earthworks during their construction and associated ritual and feasting activities, traditional narratives, place names and particularly the function or performance they undertook. Crowns used in ritual events, as tombs for high-status individuals, or as sentry posts assume the character of the activity to become a sacred or powerful place.

10.4 A Defensive Settlement Pattern

Settlement patterns reflect how social groups interact with the natural landscape, identify the relationship of people to resources and imply land tenure to define communities and territory (Bintliff 1999; Earle 2000). Babeldaob’s earthworks have a very clear distribution (Figure 34) that many archaeologists observe as forming a defensive pattern (Osborne 1966; Snyder 1997; Liston and Tuggle 2006). Butler (1984:35–36) notes that:

there are large contiguous areas of terraces occupying a single ridge system or hill with features of a clearly defensive character placed to control key access points into them . . . the prevalence of low fat-topped crown or mound features located on the margins of these complexes at points that controlled access into the complex.

After placing the earthworks into an interpretive framework of a regional settlement model, Liston (2007) and Liston and Tuggle (1998, 2001, 2006) propose that the bulk of community activities took place on the earth structures, with the clusters defining small-fortified polities. They propose that:

Palauan societies never became hilltop chiefdoms *sensu stricto* (Earle 1997), but they became something equivalent, where the ridges and hilltops were used as a defensive perimeter for each cluster of agricultural terraces, dispersed non-terraced dryland fields, villages, and associated sites. [Liston and Tuggle 2006:163]

Snyder et al. (2011) also place the terraces in a settlement system model to integrate their structure and organization with the environment and the ideational. They characterize Palau's settlement patterns as shifting between degrees of dispersed and nucleated in response to changing environmental and social conditions. The archipelago's "landscape and resource diversity led to an inherent dynamic plasticity in settlement" that allowed Palauans to maintain sustainable ecological relationships over long periods of time (Snyder et al. 2011:156).

The monumental earthworks mark the landscape as a territorial land unit on multiple levels. By delineating space, they formalize land tenure and identify property rights to those both inside and outside of the earthwork district. As large immobile objects, they advertise the power and status of the person(s) financing the structure's construction and emit meaning related to their function. Earthworks memorialize the communal act of the construction process (Tilley 1994; Phear 2007), serve as the stage for ritual, ceremonial or other significant events and contain ancestral burials to imbue social meaning to specific places and link the community to the land.

The spatial relationship of Babeldaob's earth structures that largely creates the Earthwork Era settlement pattern takes two forms: between and within earthwork districts. As there is not yet enough chronological data, temporal transformations in either pattern can not be firmly identified.

10.4.1 Inter-District Settlement Pattern

Earthwork Era Palau displays a multimodal settlement pattern defined by earthwork clusters interpreted to represent independent competing polities (Liston and Tuggle 2001, 2006; Liston 2007). District boundaries are identified by the extent of the built landscape in conjunction with natural features of the physical landscape (e.g., shorelines, rivers, large outcrops). Some perimeters may be delineated by other archaeological features, such as petroglyphs. Territorial property rights probably extended from the reef inland. Separating each district are buffer zones of largely unmodified and savannah covered terrain containing few sites.

Settlement on Babeldaob has likely always gravitated to those easily defensible areas with the most abundant and diverse resources. Favoured would be those places providing easy access to the lagoon and channels through the reef leading to the ocean, containing plentiful wetlands, and bordering the largest watersheds. Large conjoined complexes of earthworks are located in each of these areas, as well as along the neck of the island which lacks a larger watershed.

The patterning of the built landscape and the most imposing structures indicates a significant concern with competition, warfare and defence. High hills shaped into impressive crowns are strategically located to control access into the earthwork district by land and in some cases from the ocean. The massive Type IIIa Ngulitel and Ngedesaker complexes block the borders of earthwork polities with a commanding presence. Significantly sized stone pavings descend the lagoonal facing steep slopes of the Sisngembang and Roismelech earthworks to loom over the landing sites below.

Babeldaob's division into land units implies the political and economic independence of each district. However, the complex trail system identified by causeways extending inside districts and through buffer zones to connect districts suggests polity interaction. As does the similarity in scale, design and complexity of earth architecture within and between districts. These parallels are a means of promoting group unity and reflect a shared common identity

among the island population. The level of inter-district trade and reciprocity is unknown and districts may have formed alliances for food security, warfare or protection.

There was likely a settlement hierarchy that changed through time based on the strength and ability of individual leaders or groups to form alliances and wage warfare. Although Ngaremlengui and Aimeliik appear to be the largest earthwork polities and contain the most elaborate structures, none of the districts have been thoroughly archaeologically surveyed. The largest structures and area encompassed by a polity may still be under forest cover. Regardless, the extent and distributional patterning of earthworks on the current landscape is a culmination of centuries of occupation and would only reflect their final hierarchical arrangement.

Earthwork polities never expanded beyond their final configuration to eventually conjoin perhaps because of a combination of several factors relating to demographics, resources, human agency and natural environment. There may have been a limited capacity to accommodate the increasing workloads required to maintain additional earth structures and soil fertility if the district expanded too much. Spreading out increased the distance to the rivers and shorelines which would substantially raise the effort expended in transporting lime and other products into dryland cultivation areas.

10.4.2 Intra-District Settlement Pattern

The districts of contiguous earthworks extend from the coast inland to contain dryland agricultural fields and pondfields, fortifications, burial grounds, ceremonial centres and ritual features, elite residences, villages and habitation areas, pottery production centres and other activity areas. The distributional patterning and morphology of earthwork complexes shows boundary definition and defence tied to economic control of landesque capital and other earth structures not only between but within earthwork polities.

Few residential complexes are identified in earthwork districts. This may be due to the dispersed nature of interior habitation at the household level and some population centres

being located on the coastline where they are currently under current stonework villages, beneath the lagoon or covered in erosional sediments. Where feasible, the focal point of settlement activity may have been behind natural barriers on the coastline, along the inner margins of deep bays and above interior waterways offering easy access to the lagoon.

Identified nucleated settlements are located on easily defended ridgelines and step-terraced hillslopes that afford a view of the coastline or river below and provide a breeze (Liston 2011b). These small villages are archaeologically defined by some combination of earth platforms, rudimentary stone architecture and dense artefact scatters (Liston and Tuggle 2006; Liston 2007a, 2011b). Nucleated Earthwork Era settlements may be on the large hills with levelled summits and slopes shaped into alternating radiating gullies and step-terraced ridges (Type II) and levelled ridges (Type I). Perhaps a large proportion of the remaining population may be dispersed households spread through the agricultural terraces. These dispersed domestic units are identified by large garbage pits, postholes and minimal stonework (Liston and Rieth 2011). Groups of warriors may have lived along the outer perimeter as well as inside the districts to guard territorial borders and perhaps monitor their own polity's population.

Rain-fed agricultural areas are incorporated into the district and surrounded by other earth structures or one side may open onto a waterway or face the mangrove edging the lagoon. In general, complexes of step-terraces, basins and gullies are near rivers, streams and coastlines. Smaller agricultural units on individual step-terraces, basins, and gullies supporting household gardens, ritual or elite production areas are found on almost all earthwork complexes so that interior or dryland terrestrial production was never entirely restricted to step-terrace complexes (Type IV). By the end of the Earthwork Era, particular step-terrace complexes may have been reserved for the sole use of the elite who consumed the produce not needed for surplus.

In addition to their high vertical slopes, terrace occupational areas gained protection from the surrounding terrain by being incorporated into clusters of earthworks and natural barriers. Defensive ditches bisect ridges leading to settlements and hill summits to inhibit attack. In

their physical defensive capacity, crowns supported surveillance, smoke signalling and places of refuge. High crowns surround habitation and cultivated areas while squat crowns are positioned to overlook adjacent field systems (Liston 2007b).

Elite or ceremonial centres and ritual areas are on levelled ridgelines and crown summits, highly visible to the community and only accessible to a few. The sheer slopes and small summits of the crowns allowed for limited access. Restricted or private space is also created by ditches, particularly those around crowns.

Descending between substantially higher earthworks and overlooking structures on either side, the prominent saddle terraces on Ongelwatel (Figure 28) and Roisingang may be venues for events meant to be watched but not approached by the public. Although not the most imposing structure on the landscape, the saddles are large enough to hold a small group taking part in ritual or ceremonial events or high-status activities.

The majority of earthworks do not assemble into closed architectural sets and are relatively easily accessible when approached from connecting earthwork structures. A single structure can be inaccessible unless approached from a specific side. Formal central places for public assembly are not identified in the Earthwork Era's archaeological record although open unstructured spaces (e.g., Imengel) large enough to accommodate large public gatherings, feasts or meetings are common to the earthwork landscape. In general, earthwork districts do not contain a single dominant structure. This may be due to the merger of smaller groups, each with their own earthwork structures, through a period of time.

The patterned disposition of types or sizes of earthwork complexes and activity areas inside districts is not yet identified. This distribution could identify political factions or kin-based groups. The patterning on the current landscape of conjoining earthworks may have taken centuries to progress from smaller to progressively larger sociopolitical units to eventually merge into a united polity. It is highly likely there is an intra-district settlement organization with potentially hierarchical differences but additional research is needed to distinguish the key markers.

10.5 Summary

The Earthwork Era multimodal settlement pattern with contiguous earthwork complexes grouped into large clusters separated by buffer zones suggests inter-district competition and conflict, hierarchical relationships and political centralization. Preoccupation with competitive behaviour is identified early in the cultural sequence by construction of earth structures far beyond any practical use to serve as symbols of power by ca. 2000 calBP.

As durable objects, earthworks identify territorial boundaries placed to control staple resources and the valuable landesque capital. Deliberately locating imposing monumental structures so they are highly visible to other polities and control key access points suggests that rival groups may have largely competed by posturing rather than outright combat. These monumental earthworks symbolically display the status and authority of the leaders by manifesting the power and message of the dominant ideology to those within and outside of the polity.

The intra-polity settlement pattern reflects a fusion of corporate and exclusionary strategies. Despite the large clusters of earth structures suggesting political centralization, the intra-district settlement pattern reflects decentralization. Polities display a multi-village settlement organization, lack of a central place or single prominent structure and do not form closed architectural groups. By being open to the public and able to contain a sizeable gathering, the large open spaces reaffirm community identity and group ideology rather than individual recognition (Blanton et al. 1996). Ritual or ceremonial areas are visible to everyone in the community although the rites performed on them are only accessible to a few.

Rather than identifying a corporate strategy, a large open assembly space could have been used by the ruling elite for public speeches, to distinguish individuals in ritual events or bestow honours. Structural surfaces are difficult to access unless approached from particular locations and some occupied areas are blocked by ditches. Additional architectural evidence of network strategies inside districts is found in symbolic posturing with large structures clearly visible to the local community and low crowns that may have been watchtowers overlooking

those in the immediate area. These network strategies serve to promote individual political actors rather than large groups.

Earthworks were a significant component of Babeldaob's sociopolitical system for over a millennium. Their dimensions and distribution are a significant indicator of both the strategies used and the success of those strategies in politicizing the landscape. The current distributional patterning is the final configuration of the Earthwork Era settlement pattern and may not reflect the political organization and structure through the entire period of occupation. The distinct inter-district pattern is contradicted by no readily identifiable formalized internal land tenure system inside earthwork polities. This may indicate that different political economic strategies operated on different scales during the Earthwork Era. A model of the evolution of Earthwork Era sociopolitical organization that is expressed in the earthwork architecture is presented in the following chapter.

In the following chapter, a model for the economic and sociological organization of the spatial system is proposed. The model is based on the following assumptions: (1) the spatial system is a complex system, (2) the spatial system is a dynamic system, (3) the spatial system is a hierarchical system, (4) the spatial system is a network system, (5) the spatial system is a system of systems. The model is based on the following assumptions: (1) the spatial system is a complex system, (2) the spatial system is a dynamic system, (3) the spatial system is a hierarchical system, (4) the spatial system is a network system, (5) the spatial system is a system of systems. The model is based on the following assumptions: (1) the spatial system is a complex system, (2) the spatial system is a dynamic system, (3) the spatial system is a hierarchical system, (4) the spatial system is a network system, (5) the spatial system is a system of systems.

11.2.1. The spatial system is a complex system.

The spatial system is a complex system, which means that it is a system of systems.

11.2.2. The spatial system is a dynamic system.

The spatial system is a dynamic system, which means that it is a system that changes over time.

The spatial system is a hierarchical system, which means that it is a system that is organized into levels.

The spatial system is a network system, which means that it is a system that is organized into a network of nodes and links.

The spatial system is a system of systems, which means that it is a system that is composed of many smaller systems.

The spatial system is a complex system, which means that it is a system of systems.

The spatial system is a dynamic system, which means that it is a system that changes over time.

The spatial system is a hierarchical system, which means that it is a system that is organized into levels.

The spatial system is a network system, which means that it is a system that is organized into a network of nodes and links.

The spatial system is a system of systems, which means that it is a system that is composed of many smaller systems.

The spatial system is a complex system, which means that it is a system of systems.

The spatial system is a dynamic system, which means that it is a system that changes over time.

The spatial system is a hierarchical system, which means that it is a system that is organized into levels.

The spatial system is a network system, which means that it is a system that is organized into a network of nodes and links.

The spatial system is a system of systems, which means that it is a system that is composed of many smaller systems.

The spatial system is a complex system, which means that it is a system of systems.

The spatial system is a dynamic system, which means that it is a system that changes over time.

The spatial system is a hierarchical system, which means that it is a system that is organized into levels.

The spatial system is a network system, which means that it is a system that is organized into a network of nodes and links.

The spatial system is a system of systems, which means that it is a system that is composed of many smaller systems.

The spatial system is a complex system, which means that it is a system of systems.

The spatial system is a dynamic system, which means that it is a system that changes over time.

11.0 MODELING EARTHWORK ERA SOCIOPOLITICAL ORGANIZATION

In the following chapter, a model for Earthwork Era sociopolitical development is proposed that tracks changes in terms of archaeological interpretations of the spatial patterning, dimensions, morphology, construction processes and functions of Babeldaob's monumental earthwork landscape. Timing the appearance of and transformations in the nature of Babeldaob's earth structures follows the evolution of the economic production system. In this model, agricultural intensification, earthwork development and political evolution are inextricably linked.

11.1 Early Phase

The shoreline that greeted Babeldaob's colonizers bore little resemblance to today's coast. The current extensive alluvial flats, wetlands, and expanses of mangrove forests were lacking due to such changes as higher sea level, island subsidence and, most importantly, coastal sedimentation (Dickinson and Athens 2007). A steeply sloped bench constricted the majority of the coastal margin and imposed spatial restrictions on exploitable wetlands and easily habitable areas.

At first, the high yields and low labour inputs for swamp cultivation probably induced settlers to primarily rely on this agricultural strategy. In part due to the lack of a coastal margin, the growing population chose to expand into Babeldaob's interior in search of cultivable land and habitation space (Osborne 1966; Athens and Ward 2005; Liston and Tuggle 2006; Liston 2007a). Other factors contributing to the move off the coast may include a change in sea level resulting in saltwater infestation of the cultivable coastal margin and long-term insect invasion or disease decimating the wetland crops. Where viable, wetland cultivation and shoreline settlement continued throughout the period of interior use (Masse et al. 2006).

The fertile alluvial soils along the major riverbanks and the margins of Ngeremeduu, Ngerchemiangl and Airai Bays were prime locations for initial cultivation and settlements.

Two pits in Ngeskebei, adjacent to Ngeremeduu Bay on Ngaremlengui's southwest corner, produced a combined calibrated date range of 3380–3000 BP, the earliest archaeological dates in earthwork deposits. Such early assays might indicate that landscape modification began almost immediately after colonization. Several radiocarbon dates from disturbed deposits in the Ngebars area of Ngatpang, indicate all habitable margins of Ngeremeduu Bay were likely inhabited at the same time as the Ngeskebei area. The substantial cutting and levelling to the landscape revealed by these deposits may be a direct consequence of the pressure for flat occupational surfaces due to the constricted shoreline.

Swiddening expanded the subsistence base to provide basic staple resources and ensure food security. Interior Babeldaob is not particularly suitable for sustained intensive agriculture due to the infertile erosion prone oxisols. Despite initially delivering higher yields, burning in swidden cultivation diminishes stores of nutrients so that soil fertility is quickly lost. The cultivators must have frequently relocated across the lowland zone to access previously unexploited areas. Paleoenvironmental evidence indicates a large portion of Babeldaob's thick forest vegetation was removed, largely as result of the need for productive cropland in the large-scale swidden cultivation system (Athens and Ward 2005).

Swidden cultivation does not inevitably lead to the development of step-terrace agricultural systems. Highly weathered volcanic soils with very low native fertility cover over 80 percent of Babeldaob. Due to a combination of these fine textured silty clays, the prevalence of moderate to steeply sloping topography and frequent and intense precipitation, Babeldaob's terrain is highly susceptible to erosion once its protective vegetation is removed. Erosion washes away the thin topsoil providing most of the nutrients and negatively impacts lagoon resources and fresh water sources. Along with the fertile topsoil, additives needed to keep the soil fertile wash downslope at the first rains. Sedimentation generated by the rapidly expanding deforestation would compound the problem of a constricted shoreline resulting in additional relocation of the population inland.

11.1.1 Architecture

Removing earth to accommodate level activity areas may have begun in areas close to the coast by ca. 3200 calBP. The vantage points offered by high hills such as Ngerulmud ensures their use as communication posts, lookouts and perhaps ritual centres of symbolic significance early in the cultural sequence. It is possible that large-scale flattening of hilltops, levelling and expanding ridgelines and shaping small earth platforms did not begin until a few centuries before 2200 calBP as evidenced at Ngerulmud and the Tabelmeduu ridgeline. This marks the Early Phase (2400–2150 calBP) of the Earthwork Era.

Tabelmeduu is interpreted as a ceremonial or elite centre based on the paucity of domestic midden in contrast to the quantity and variety of atypical and specialized features of potentially ceremonial association (Liston 2008, Tuggle 2011). This behavioural pattern was occurring at the earliest stages of site construction and continued until the site was no longer being used to its full capacity at possibly 1700 calBP. Although ritual is highly suggestive, the nature of this activity is far from obvious and could include elements of burial preparation, warfare or defensive positioning, political aggrandization and elite sanctioned activities (Tuggle 2011).

11.1.2 Sociopolitical Organization

During this early period, swiddening systems were likely part of the domestic economy and did not produce beyond what was required to supply day-to-day needs. With an economy based on staple food production, labour could have originated at the household level.

With the realization of the particular challenges associated with Babeldaob's erosion prone and infertile soils, the need for building efforts integrating agriculture and water control features into complexes of step-terrace became apparent. Also quickly employed was the production and distribution of the literally tons of green manure, crushed coral or calcareous sand and other soil additives required to maintain soil fertility.

This would take engineering skill and planning but the still relatively small complexes of multiple step-terraces may have warranted comparatively minimal labour requirements, perhaps at the kin-based level. As a significant contributor to the group's subsistence base, this collective labour could be guided by the elder or chief of the group without coercion. These small public works features expanded with the kin-groups across the terrain close to fresh water sources.

The presence of the elite or ceremonial centre at Tabelmeduu is the only evidence of Babeldaob's sociopolitical structure at this time. Further investigations of the ridgeline's function are needed before inferences about sociopolitical behaviours can be made. It does suggest there was some form of authority structure, perhaps based on weakly differentiated inherited power. Palau's earliest form of sociopolitical structure may have been heterarchical (Crumley 1995). With responsibilities dependant on context of the situation, co-existing individual and community power bases might have made detrimental decisions and organized projects.

11.2 Middle Phase

The first part of the Middle Phase (ca. 2150-1500 calBP) of the Earthwork Era is a period of immense development in earth architecture and transformations in sociopolitical organization. Initial efforts at flattening rolling terrain expanded into elaborate landscape modifications. Simultaneously the perhaps largely kin-based chiefdoms heterarchical social structure became more progressively more ranked. By the latter half of the Middle Phase, landscape modification had expanded to encompass large areas of contiguous earthworks. Practical earthwork functions continued, at times in slightly modified capacities, and the structures took on even more symbolic roles. These changes mirror the evolution of the sociopolitical system into polities possibly governed by councils of chiefly leaders with each chiefdom remaining largely independent.

11.2.1 Architecture

The Middle Phase of the Earthwork Era saw a substantial increase in the extent, forms and function of earthwork architecture. Elevation of hilltops was already underway by 1900 calBP as evidenced by Ngeremeduu and suggested by Roismelech. Rain-fed step-terrace agricultural systems developed into large complexes of *landesque capital*. Modified ridgelines and terraced hillslopes close to the cultivated fields held dispersed small kin-based habitation areas. Ritual architecture becomes a significant part of the earthwork landscape.

In the latter half of the Middle Phase, earthworks began to play a more important role in boundary maintenance and defence and as symbols of prestige and authority. The earthwork landscape had become a stage on which political events occurred and in which power was expressed.

Earthwork structures became the most valuable commodity in the political economy. In addition to the land itself, their value is gained from being: 1) *landesque capital* that supported the economic production system, 2) a built landscape representing a substantial long-term allocation of energy, 3) the primary symbolic source of ideological and military power and 4) the foundation of community identity through the embodiment of memories and traditions.

Agriculture

Larger, more complex and more productive step-terrace cultivation systems were probably developed through technological innovations and bigger workforces. These intensive systems became valuable capital that demanded high maintenance. An enormous effort is needed to maintain soil fertility and keep crop yields from declining in the acidic aluminium rich soils. Structural maintenance of structures, and production and distribution of adequate amounts of obligatory soil ameliorants would be a full-time occupation of a substantial workforce.

Ritual

Ritual Construction

The onset of ritual is associated with the early construction of large-scale earthwork structures. By ca. 2100 calBP, whole pots, ceramic caches and other ritually significant objects were being deliberately inserted beneath and in earthwork fill simultaneously with the construction event, suggesting their ritual interment (Liston 2008, 2009; Tuggle 2011). At Tabelmeduu, whole vessels and pottery caches are densely distributed among and under the earth platforms lining the flattened ridge to form subfeatures almost exclusively representing construction activities. At Roismelech, unique whole vessels are placed on carefully prepared alters before being deeply buried in construction fill. Ritual vessel deposition is also identified under earth platforms on the terraced slopes of Toimeduu.

The nature of the ceremonial or ritual aspect accompanying earthwork construction is unclear. The vessels may be offerings to the gods to petition for the successful construction and long-term stability of the earth structure, to honour those financing the construction or a marker to memorialize a significant event or the planned function of the completed structure. Or, the ceremony accompanying the construction process may have not been related to the planned or eventual uses of the complex.

Ritual Cultivation

The significance of the subsistence economy is suggested by ritual cultivation basins carved into hill summits by at least 2120-1900 calBP (WK-28531), an activity that may have continued until about 1100 calBP. Construction of these basins required complete alteration of the hilltop, and in the case of the impressively located Ngedelchong, cutting almost vertical hill slopes leading to the basin.

The basin's importance is identifiable by its relatively small size and largely inaccessible placement on a conspicuous elevated structure. Whereas access was restricted to a small segment of the population, activities on the crown could be viewed by the entire community.

Accompanied by ritual activities, priests or other high-ranking individuals could grow the limited quantity of cultigens, medicinal plants or ornamentals dedicated for use in ceremonial events or for consumption or use by the upper class. In addition to this sociopolitical association, ritualization of cultivation may be related to the substantial effort required to produce crops and demonstrate a vulnerability to environmental perturbations.

Structured Burial Sets

Earthwork Era interments are found in small structured burial sets high on the ridgeline extending the length of Ngaraard's earthwork district (Tuggle 2007; Liston and Rieth 2011). Radiocarbon dated to between ca. 2000–1700 calBP, the three upland gravesites (Rois, Mesesuiuil, Toimeduu) are defined by east-west orientated burial pits capped with varied combinations of clay, sea sponge mats and small pavings or rock mounds. The communal burial areas are associated with a few grave goods such as whole pots containing perishable offerings and, in one instance, a cache of round basalt cobbles. The burial furniture is not identified as connected with a particular grave, although it may be.

Whether the primary purpose of these relatively unobtrusive earthwork components was for human burials or whether gravesites were incorporated into the households dispersed throughout the area is not known. Mortuary activity on particular earth structures may have been prohibited to all but members of a specific kin-group or restricted to the upper class.

Territorial Markers and Defence

Babeldaob's earthwork structures expanded to form ten spatially contiguous landscapes of modified terrain separated by gaps of untterraced land with few archaeological sites. These territorial units defined by earthworks legitimized corporate claims of land and other resources (Liston and Tuggle 2006). Some high crown complexes functioned as markers of particular resources or entryways, and formed strategic perimeters. Within each earthwork district, earth structures were built far larger than needed for practical use. This defensive settlement pattern identifies inter-district competition and rivalry. It is possible that smaller territorial units are contained in the larger earthwork districts. They may someday be identified by boundary

markers, a patterned distribution of ritual cultivation basins, central villages or the relative size of groups of contiguous structures.

Along with their other roles, many crown earthworks served interconnected defensive functions, only one of which is to mark a boundary. The lines of sight provided by their height made them effective as signal towers and sentry posts for long-distance surveillance. Crowns may have served as places of refuge and fortified residences. Ditches bisected ridgelines to defend habitation and activity areas from attack and circled crowns to create restricted space. In this sense the defensive capacity of earthworks was largely in preventing or shielding the occupants from attack and identifying spatial units.

Symbolic Structures

The spatial distribution, magnitude and morphology of earthworks identify a significant concern with symbolic expressions of political power (Liston and Tuggle 1998, 2006; Liston 2007a). The size of many earth structures is far larger than any practical function demands. Adept manipulation of the topography created the illusion of even more massive imposing structures from afar. This ostentatious display of structures as ideological symbols is implied by the wealth needed to construct and maintain the massive structure and by the ability to mobilize, manage and engineer the construction process.

The earthworks created a politicized landscape through their practical and symbolic functions. Although not all structures are directly associated with elite activity, the entire earthwork landscape became politically charged with symbolism through its links to past and present activities and its reflection of labour investment and engineering expertise. This advertisement of strength and prestige enforced and legitimized elite ideology to intimidate and impress both the surrounding population and other polities. In this manner, the local group was constantly reminded of the control and power of the ruling class.

11.2.2 Sociopolitical Organization

As the erosion control, earthwork construction and agricultural production techniques and technology became more refined sociopolitical organization developed. In large part due to the desires of the emerging leaders (cf. Janusek and Kolata 2004) to ensure food security and to create surplus, the step-terrace complexes become larger and more elaborate. Morphologically varied earth structures were built to support other activities in the rolling terrain.

Construction of large earthwork complexes requires not only an enormous labour effort but also a thorough knowledge of soil mechanics, hydrogeological conditions and engineering principles. Those with advanced technological knowledge, developed engineering expertise and extensive organizational capabilities were likely responsible for designing and directing the building and maintenance of these more complex structures. Earthwork engineers may have become an important commodity for powerful members of society.

To alleviate prolonged erosion control measures and increase agricultural production, the collective labour of a larger group could build an entire complex in one or two dry seasons. Neighbouring kin-based cooperatives may have constructed the first large-scale step-terrace complexes and other earthwork structures. Organizing, financing and managing the workforce needed for these public works became the responsibility of the leader(s) of the host group. The leaders recognized the strategic advantage in reinforcing their sociopolitical position by sponsoring the neighbouring community. Ritual activities and feasting during the construction event not only helped obtain communal labour but publicly expressed the host community's wealth to the visitors and became an opportunity to acquire prestige and solidify reciprocal relationships (Dietler and Hayden 2010; Hayden and Villeneuve 2011).

Along with promoting group solidarity, these multi-community long-term work projects could quickly transform into competition between communities (Renfrew 1986; Kolb 1992) to build ever bigger and more elaborate structures. This contest for status and prestige extended to the associated feasting and ceremonial activities. Larger and more productive cultivation

systems were needed to support an increase in crop yields from the basic subsistence regime to the surplus production needed in competitive feasting, food presentation and exchange.

The now substantial communities supported kin-based chiefdoms with an economic base in landesque capital, the staple economy and knowledgeable engineers and priests. This political transformation was dominated by political actors striving for personal prestige to attract a faction of supporters beyond their small kin unit (Brumfiel 1994). Surplus to finance the elite's competitive strategies was acquired through tribute of produce, marine foods and labour. As the landesque capital, and other earthworks, in a chiefdom may have been owned as a cooperative, political actors attained some of their power from ritual and authoritative knowledge. This could lead to constructing more symbolic and ceremonial structures. The rise of the Earthwork Era elite is intertwined with the transformation of the political economy from a subsistence to a surplus-based economy which is thoroughly grounded in earthwork construction and use.

Multiple small chiefdoms are suggested by the large number of ritual cultivation basins, a rite that began by about 2000 calBP. The massive earthworks constructed far larger than needed for any mundane use, also beginning about 2000 calBP, suggests competing groups manoeuvring for more prestige. Despite the lack of enough data to identify bounded or hierarchically organized smaller groups inside the larger earthwork polities, this trajectory of sociopolitical complexity could explain the vast extent of earthworks so early in the cultural sequence. Inside each polity there may be multiple nucleated religious or political centres or central villages, each on its own section of freshwater, bayfront or coastline. These areas, possibly identified by Type II complexes, may form the central place for each small chiefdom.

The complex process of protecting and controlling the investment in the landesque capital, producing surplus to enhance prestige and jockeying for position among leaders of neighbouring chiefdoms led to rivalry and alliances. In time it became economically productive for the leaders of the bordering kin-based units to unite. Consolidation met the common goals of ensuring labour and technical knowledge for large-scale projects, protecting

capital investments from outside attack, providing food security during periods of stress, forming resource exchange networks and offered the benefits of mutual feasting, ritual activities, authoritative knowledge and public works.

The chiefdoms consolidated to form territorial units identified by conjoining earthworks centred on the larger watersheds and separated by buffer zones. This implies political centralization; however, without a central place or obvious hierarchical organization of earthworks, the distributional patterning inside the polities suggests decentralized complexity. Despite being subsumed within the larger polity, each chiefdom retained their internal organization. A council of loosely ranked chiefs may have administered the polity. This would not entirely eliminate social stratification or the accumulation of wealth but could diffuse hierarchical authority. The competition between chiefdoms for rank on the polity's ruling council constrained the power of individuals who attempted to manoeuvre for more control. Intra-polity relations may have always been fragmented with fragile alliances based on marriages, feasts and gift-giving with significant concerns negotiated through the polity council.

Rather than field systems falling under centralized management, the land tenure system could have remained in place with each chiefdom maintaining administration of its own agricultural production. Tribute goods and labour was presented to the chief to support activities in their chiefdom, with a portion allocated to the polity council. While labour for the faction may have entailed earthwork maintenance and acquisition of soil ameliorants, polity labour was dedicated to: 1) construction of earth defensive features and structures identifying boundaries, polity power and ideology and 2) warfare in the form of sentry or combat duty.

The level of inter-polity rivalry defined by the settlement pattern and size of structures is unknown. The defensive posturing based on the ostentatious display of wealth and power through monumental earthworks was meant to intimidate other polities and prevent them from encroaching into enemy territory. The extensive interior trail network, long-distance smoke

signalling and similarity in the island's earthwork morphology suggests there was a significant amount of interaction and cooperation between polities.

11.3 Late Phase

By the Late Phase (ca. 1500–1100 calBP) of the Earthwork Era, there are distinct signs of personal aggrandization implying chiefdoms may have gained hegemonic control over some polities. This evidence for individualized power overlaps with the abandonment of the earthwork districts which suggests their association although the catalyst(s) is unknown.

11.3.1 Architecture

The changes in earth architecture in the Late Phase include the addition of high-status interments, direct evidence of warfare and the cessation of ritual cultivation in the crown basins.

In the Late Phase, small earth elements were added to the summits of pre-existing highly prominent crowns to accommodate elaborate formal interments. A stone-lined pit beneath an earth knob on the previously built Roisingang crown complex is interpreted by Tuggle (2011) as marking the burial of a high-ranking individual. Ritual, identified by a red-stained matrix and whole pots, accompanied the adults buried over a period of time in a newly constructed berm on Sisngebang's crown. The significance of the Sisngebang summit at the time is exemplified by a pot cache containing unique annular based, decorated vessels. The structured burials on Roisingang occurred around 1530–1060 calBP while those on Sisngebang took place around 1080 calBP and perhaps a little earlier.

The only currently identified palisade post, placed in the inner margin of a ring-ditch, is dated to 1420–1290 calBP (Liston 2011b). Competitive behaviours and conflict extending back to at least 2000 calBP may have accelerated in the Late Phase. However, the escalation of warfare cannot be tracked as there is no radiometric data for the instigation and prevalence of barriers, boundary markers, signal towers, sentry posts, places of refuge and other defensive features.

The commonly performed rite involving ceremonial cultivation on crown summits ended towards the end of the Earthwork Era. In some cases, crowns with basins, or the ritual behaviour, may have simply been abandoned. An intentional termination of the rite is identified in the deliberate infilling of some basins. This may be due to a combination of expunging older traditions, reacting to a crisis that the cultivation rituals were not addressing, or needing the highly visible crown summits for other activities, such as high-status interments.

11.3.2 Sociopolitical Organization

In the proposed model, earthwork polities were not internally homogenous and stable. The somewhat hierarchically organized rival chiefdoms in each polity were extremely dynamic as they constantly manoeuvred for prestige and authority. Competitive behaviour inside polities is evidenced by the lack of central place, the number of individual ritual areas and the magnitude of earth structures distributed throughout the district. Conflict and the rise of a dominant chiefdom could be mitigated by a ruling district council who implemented corporate leadership strategies to unite the population in a network of reciprocal relationships.

At the same time, the chiefly polity council jockeyed for position with the other polities on Babeldaob and the neighbouring smaller islands. As the councils gained influence over their own populations and formed alliances with competing polities, the friction between the elite council members increased. The identification of territorial units becomes a critical element in polity competition.

This dissension may have been fuelled by a mixture of environmental, social and cultural stresses. Climate perturbations, demographics and transformations in the subsistence regime, among many other variables would destabilise the authority of the ruling elite and precipitate societal transformations during the final centuries of the Earthwork Era. These fluctuations could undermine the population's confidence in the effectiveness of established rituals and ceremony and lead to questioning the power of the ruling elite and their connection to the demi-gods.

If the terrestrial subsistence economy was at risk, extensification of the agricultural systems beyond the boundaries of the earthwork clusters seems to be a valid option. The neighbouring land's edaphic condition is no different from that already under cultivation. Several factors could prevent this opportunity, such as: 1) a lack of available land along the major waterways or shoreline able to accommodate the import of lagoon-based soil additives, 2) the labour force was fully engaged, 3) environmental stressors affecting the entire area or 4) the land defensible by the population had reached its maximum extent. Regardless, the fact that districts did not expand horizontally suggests that an increase in dryland yields was either not possible or not the primary issue.

Strife led the elite to focus on network leadership strategies, notably personal aggrandization, to gain a dominant position. Structured high-status burials accompanied by ceremony supplanted ritual cultivation basins on crown summits. The crowns are clearly visible from the lagoon and across large portions of the island to symbolically represent the occupant's power and prestige. These prominent locations may have also been chosen to renew traditional and ancestral connections with the past (Phear 2007). Potentially identifying personal aggrandization is the iconographic symbolism found in the monolithic carved stone faces (*klidm*). Although without a clear timeframe, the *klidm* transformed from abstract (Figure 61) to more realistic features showing individual actors (Van Tilburg 1991). This final manifestation shown in Figure 62 may represent elites publicly advertising their status or exploits to the population.

Reorganization of the power structure probably resulted in restructuring the earthworks to symbolically legitimize and enforce the emerging elite. In larger, powerful polities, previously constructed earth structures may have been remodelled and enlarged to create central places. Although not yet archaeologically investigated, renovation of the compact cluster of immense earthworks in the Aimeliik polity could focus attention on a central, powerful chiefdom. Some re-structuring was likely due to warfare that may have intensified during the final centuries of the Earthwork Era.

Sealing ritual basins suggests there was no longer a need for the ceremony associated with cultivation of the step-terrace systems. This might signal the transformation of the subsistence regime from a dependence on dryland to wetland field systems. Always a component of the Palauan subsistence economy, the wetlands might have reached the critical stage of expansion where wetland taro production could support the population and produce adequate surplus and prestige goods. In traditional Palau, wetland taro is valued over dryland varieties, is the crop most mentioned in oral histories and is the most significant ceremonial-exchange food.

This transference in the political economy would upset the balance of power. Powerful chiefdoms dependant on an abundance of dryland fields may not border the swamps and marshes needed for wetland taro production while chiefdoms with few dryland systems may now contain plentiful wetlands. As the taste of wetland taro is partly dependant on soil quality, even smaller pondfields could produce highly valuable goods. Combined with other variables, this reduction or gain in economic worth could dramatically impact the sociopolitical system.

The ensuing conflict within earthwork polities could result in districts and chiefdoms splitting apart or one leader gaining hegemonic rule over the entire polity. Less powerful kin-groups or chiefdoms could leave or be banished from the protection and security of the larger earthwork district. The small congregations of comparatively minor earth structures in the buffer zones separating earthwork polities may be a result of these disenfranchised groups. Dated to the Late Phase (1340–1070 calBP) is the major construction phase at Isakos, a terrace complex located between two earthwork polities (Tuggle 2007).

11.4 Abandonment

The decline of the earthwork polities occurred over centuries rather than as a relatively concurrent short-lived process. By about 1100 calBP, the earthwork polities were largely abandoned. “Abandonment” refers to the final use of earthwork structures *as components of integrated political units*. Palau’s earthworks have never been subject to wholesale abandonment as most, if not all, post-Earthwork Era villages were built on step-terraces and

many interior activities, such as bird and pig hunting, gathering of economic plants and cemetery burials continue to occur on the interior's built landscape.

A substantial amount of archaeological evidence strongly suggests that a significant loss of population and deterioration in power in the Ngaraard and Ngiwal earthwork polities had already occurred by 1400 calBP or earlier (Liston 2011a). The evidence for warfare combined with assays indicating the culmination of pondfield cultivation shows the decline of the Ngatpang earthwork district began just before 1300 calBP. Earthwork polities probably continued for several centuries in other localities such as Ngaremlengui and probably Aimeliik.

The lack of archaeologically documented cultural activity on Babeldaob for several centuries after the dissolution of the earthwork districts could relate to a period of societal collapse, lack of archaeological investigations or the difficulty in accessing deeply buried coastal cultural deposits (Liston 2007a). The population probably relocated closer to the wetland fields along the coastline into already established villages and dispersed across less intensively occupied areas. Although some of Babeldaob's inhabitants likely moved to the surrounding smaller islands, the increase in permanent settlements on the Rock Islands and Peleliu between 1200 and 1100 calBP (Masse 1989; Beardsley 1997; Clark 2005) is not significant enough to suggest a wholesale migration of the population (Masse et al. 2006:112). It is not until ca. 700–800 calBP that abundant archaeological evidence identifies a thriving coastal-based Babeldaob population relying on wetland taro cultivation (Masse et al. 2006; Liston 2007a, 2011a).

By Western contact in the late eighteenth century, Palauans did not recognize the earthworks as anthropogenic and they were largely absent from the rich body of traditional narratives. Liston and Miko (2011) propose that the main mitigating factor in the loss of earthworks from Palau's collective consciousness is the transformation in sociopolitical regimes expressed in both archaeological and traditional history. This change is associated with the transplantation of the subsistence economy and settlement pattern from the focus on

the interior to the coastal margins and the accompanying alteration in the political order from the earthwork polities to the hierarchically structured alliances of autonomous stonework villages (Liston and Miko 2011:196). This resulted in social dislocation, technological innovations and significant transformations in the political economy, power structure, ideology, social organization and worldview.

Mythology provided a traditional explanation to legitimize the new political, social and ideological order and establish social cohesion after this dramatic cultural transformation. When the lowlands and shoreline became the socioeconomic focus, individual inland earth structures were no longer valuable or relevant to societal functions and traditional history relegated the earthwork polities to an obsolete past. The interior earthwork complexes became ancient relics and were forgotten. In a broad sense, the archaeological record mirrors the chronological framework provided by traditional history.

11.4.1 Causal Variables

The causal variables behind the decline of the inland earthwork polities and the eventual shift to a subsistence economy based on pondfield cultivation and a more coastal-based settlement pattern are not clearly understood. The long period of transformation and the differential timing of the abandonment of Babeldaob's earthwork districts indicate this change did not occur due to a single apocalyptic event impacting the entire island. It is likely multiple interacting mechanisms related to crisis in the production economy, a move from a dryland to a wetland based economy, warfare, demographics, sociopolitical changes, coastal sedimentation or climatic perturbations contributed to such a radical shift in Palauan society.

It is unlikely that the dissolution of the Earthwork Era polities is a direct result of the lack of a long-distance trade network, isolation from other large island groups (e.g., the Marianas Islands) or a staple financed political economy. Sociopolitical organization had already developed and thrived through several transformations for a millennium under these same conditions.

Although the depletion of nutrients in Babeldaob's interior soils would severely constrain agricultural productivity (Lucking 1984), aridity in itself is only a contributing variable behind abandoning interior agriculture. The centuries that dryland fields were under production proves that the population had successfully adopted innovations to overcome the limitations of the highly weathered soils.

McCutcheon (1981:164) notes that root crops must be rotated annually in dryland gardens for optimal production and to prevent pest infestation and suggests that "this may be the reason that grassland gardens [terraces] are finally abandoned; the crops best adapted to the conditions are almost all root crops." Establishment of arboriculture on the step-terraces may have alleviated the eradication of taro during annual rotations. New varieties of dryland taro could reduce the vulnerability of food plants to pests and pathogens although a significant blight could result in the rapid and long-term deterioration in dryland yields to force the population to rely on alternative means of production.

The number of labourers needed to maintain the step-terraces and soil fertility is large enough that a significant decrease in population affects the potential of the dryland systems to produce. In the same vein, abandonment of an intensive production system often follows a significant decrease in the population that requires less food (Netting 1993). The decimation of the farming population could relate to an epidemic resulting from the introduction of diseases, substantial losses due to migration out of the polity, warfare or to local farmers being pulled off their duties to participate in polity sponsored warfare, ritual or other activities.

Conflict and warfare is likely to have played a role during the transformations but would not be the primary mechanism of change. Warfare had long been a component of Palauan society. As noted by Earle (1997:8), unless strategically directed by the chiefly body, military might is a problematic source of power. At any weak link in a transforming system, warfare and competition can turn against the leaders to destabilize political power. Warfare may have reached the stage that the population of a conquered polity might relocate to the victorious community to work as slave labour or be forced to leave Babeldaob.

Coastal Sedimentation

Coastal sedimentation is likely a significant factor in the shift in settlement patterns and subsistence regimes. As on other Pacific Islands (Spriggs 1981, 1997; Schilt 1984; Athens 1993; Kirch 1997) the long-term deposition of massive quantities of Babeldaob's upland soil onto the surrounding lowlands led to dramatic changes in the ecosystems and landscape and consequently, the adaptive strategies chosen by the island's inhabitants.

Swidden horticulture, collection of construction and fuel wood and the creation and upkeep of open activity areas and earthworks rapidly deforested the island. This loss of protective vegetative cover, and the widespread construction and use of terraces, accompanied by changes in sea level and island subsidence generated enormous amounts of erosion and sedimentation. Several millennia of soil deposition is responsible for the extension of the coastal margin and the mangrove habitat, the formation of wetlands, and the development of rich hydromorphic soils in the lowlands (Kubary 1895; Barrau 1961; Hunter-Anderson 1991; Athens and Ward 2005). The almost complete absence of species endemic to Babeldaob's marsh habitats supports the probability of their relatively recent expansion as erosional material filled low-lying areas (Costion et al. 2012).

These newly created and expanded habitats produced space for habitation and fertile wetlands suitable for pondfield cultivation (Hunter-Anderson 1991; Athens and Ward 2005; Liston and Tuggle 2006; Liston 2007a). The growth of wide spans of mangrove forests served as defensive barricades from enemy attack and continues to provide abundant and economically important resources and protect lagoon ecosystems from siltation and the shoreline from coastal erosion. Swamp forests provide a buffer of freshwater for mangrove forests during times of drought.

Taro is almost certain to have grown in Babeldaob's wetlands since colonization. A less intensive form of wetland cultivation was practiced in interior basins and available lowland swamps and marshes throughout the Earthwork Era. It was not until sufficient deposits of upland sediments eliminated the tidal influxes of salt water that edaphic conditions became

suitable for intensive pondfield agriculture (Liston 2009; Athens 2011). By at least 800 calBP, this fertile resource was likely being fully exploited for its high productivity as the staple resource.

Given the opportunity, the population might make a strategic economic choice to become less reliant on dryland step-terrace cultivation and choose to develop wetland taro systems. Wetland cultivation provides a considerably higher more reliable yield of taro per hectare than dryland cultivation and, in some cases, is less labour intensive than dryland systems (Spriggs 1981:177; Kirch 1994). Although having practiced a simpler form of wetland cultivation in interior basins since early in the cultural sequence, it is not until there was adequate wetlands did Palau's large-scale irrigated pondfield (*mesei*) agriculture begin to drive the subsistence economy.

In addition to higher yields and less labour input, a significant mechanism in the transformation to a reliance on wetland agriculture on Babeldaob may be a society that valued wetland over dryland varieties of taro. Taro grown in either *dechel* or dryland gardens is considered a vastly inferior product to the more prestigious wetland taro (*C. esculenta*, *kukau*). Early in the cultural sequence, wetland taro may have been a valuable prestige good whose social return was far higher than dryland produce. As the swamps and marshes substantially expanded, the burden placed on producers by the elite for surplus *kukau* could have intentionally or unintentionally shifted the subsistence economy to wetland systems.

As the population turned to pondfield cultivation, dryland step-terrace systems began to be less and less a priority. Villages relocated to be near the focus of primary agricultural activities, in this case the lowland swamps and marshes (Liston and Tuggle 2006; Masse et al. 2006:111; Liston 2007a). This left the interior engineered landscape largely abandoned.

Climate Change

A complimentary explanation for these transformations is offered by climate shifts. Paleoclimate research documents long-term climate variability in the Pacific region.

Unpredictable environments impact resources, ocean crossings and exchange systems to result in dramatic changes to Pacific settlement systems, political economies, subsistence regimes and political organization (Allen 2006, 2010; Field 2004; Masse et al. 2006; Nunn et al. 2007; Field and Lape 2010; Clark and Reepmeyer 2012).

Substantial fluctuations in Palau's rainfall over a long period is strongly suggested by the relatively high percentage (ca. 58%) of Babeldaob's forests that are in the medium high to highest range of drought resilience (Donnegan et al. 2007:16). Although Masse et al. (2006:110) propose that Palau's sizeable and diverse land mass should provide a resilient buffer against the effects of climate change, Babeldaob's cultivation systems are particularly vulnerable to drought. Van der Brug (1986) describes the devastation to Palau's wetland taro and dryland cassava production during the 1982–1983 El Niño event.

Food crops, which are produced mainly by subsistence farming, were seriously affected by the drought on most of the Palau Islands, except on the island of Peleliu, where no drought damage was reported. All areas of Babelthup, especially in the northern part, were affected, and losses of taro and cassava ranged from 80 to 95 percent of the crop. Taro corms wilted and dried, and the tubers turned brown when cooked. No planting of new taro was feasible as the mud in which the taro grows had hardened. Cassava roots became fibrous and remained hard when cooked. No new cassava cuttings could be planted as planting materials were reduced and the soil was too dry. New crops did not mature until about six months after the end of the drought. Most coconut and banana trees on the islands survived. [Van der Brug 1986:32]

Non-irrigated taro is reliant on soil, rain, humidity and other variables for productive yields. As a general baseline, dryland taro requires at least 250 cm of rainfall per year, although 1750 mm is sufficient if it occurs throughout the year (Spriggs 1981:144). With a current mean annual rainfall of 360 cm and mean annual temperature of 27.6°C environmental conditions in Palau are suitable for dryland cultivation. Even with the 30 percent drop (ca. 110 cm) in rainfall recorded during the strong 1982–1983 El Niño event (Van der Brug 1986), annual precipitation should have still been within the acceptable range for dryland cropping. The devastation to the crops indicates that in certain conditions Palau's rain-fed taro requires substantially more precipitation than ca. 250 cm in order to thrive.

Palau's environment is significantly impacted by ENSO and movement of the inter-related ITCZ. The extreme variations in sea level, air and sea surface temperature and tides

associated with ENSO events can result in dramatic coral bleaching, coastal erosion, saltwater intrusion into taro patches and drought (Bruno et al. 2001; RoP 2009:11). This causes a loss of critical terrestrial and marine habitat, a shortage of potable water and agricultural devastation.

Partial reconstruction of Palau's paleoclimate indicates a comparatively dryer period from about 550–300 BP due to the southward movement of the ITCZ during the LIA (Sachs et al. 2009; Smittenberg et al. 2011). Concurrent with this drop in precipitation was the increase in west Pacific droughts caused by more frequent El Niño events in the final years of the MWP (Gagan et al. 2004). Clark and Reepmeyer (2012) correlate the abandonment of the Rock Islands recorded in Palau's oral history with this period of low rainfall.

Although there is undoubtedly correlation between reduced rainfall and social and cultural change in Palau (Masse et al. 2006; Clark and Reepmeyer 2012), a detailed paleoclimate record is needed before linkages can be drawn between Earthwork Era events and climate variability. It may be that changing weather conditions was one of the mechanisms that stimulated the move into and out of rain-fed dryland cultivation systems during the Earthwork Era.

11.5 Summary

The corporate kin-based organization of the early centuries of the Earthwork Era is characterized by a political economy focused on the agrarian and marine subsistence base, shared authority and few expressions of socioeconomic stratification. Given the challenges presented by Babeldaob's edaphic conditions, limited wetlands, moderately steep topography and wet tropical climate, construction of step-terraces is modelled to be an effective land management strategy to prevent land degradation and promote soil fertility in an erosion prone and infertile environment. These choices strongly influenced the trajectory of sociopolitical evolution.

A substantial expenditure of energy was soon devoted to shaping the landscape and maintaining the long-term productivity of the rain-fed dryland field systems. Neighbouring

corporate groups assisted in construction of the *landesque* capital with leaders mobilizing, financing and organizing the communal construction events and associated feasting and ritual activity. This process simultaneously encouraged reciprocal behaviour and competition between participating groups, promoted emerging leaders, reinforced the dominant ideology and transformed the built landscape into a highly valued commodity. Strongly integrated communities with a sense of collective identity developed through collective construction projects, shared rituals and mutual ideology.

The political economy transformed into the surplus driven economy needed for hosting the multi-faceted construction events. Emerging elites institutionalized their power through kin-based corporate chiefdoms. Power and prestige was acquired through the control and appropriation of: 1) *landesque* capital, 2) surplus goods, 3) ritual and authoritative knowledge, 4) labour and 5) earthworks.

In addition to step-terraces, other forms and types of earth structures were constructed on the rolling topography to support public works, ritual performances, habitation areas, meeting and activity locales, burial grounds and defensive features. Earthworks in all their forms, took on multiple practical and symbolic roles. Imbued with ritual, traditional and economic connotations and meanings, the architecture legitimized and fortified the dominant ideology and advertised the wealth and prestige of the elite to enhance their authority. The development of complexity entailed mutually supporting roles of agricultural intensification, ideology and military power.

As the elites strove to control, protect and expand their power base it became economically productive for neighbouring chiefdoms to join into mutually supportive territorially circumscribed units. Defined by contiguous earthworks and perhaps administered by a council of loosely ranked chiefs, these polities were decentralized and fragmented. Conflict between the fragile alliances of chiefdoms and prevention of a dominant chief were mitigated by the ruling council who instigated corporate leadership strategies to promote unity. Regardless, rival factions and competing polities were extremely dynamic as they constantly

manoeuvred for prestige and authority. Evidence of personal aggrandization in the form of structured individual burials in prominent locations suggests that ultimately some chiefdoms may have gained hegemonic control over a polity perhaps after a period of more hierarchically structured polity councils.

The causal variables behind the prolonged dissolution of the earthwork polities are poorly understood. A probable motivator in the shift in settlement patterns and subsistence economies is the opportunity provided by the extension of the coastal flats and production of wetlands suitable for pondfield cultivation that was caused by long-term sedimentation. The leaders made a strategic economic choice for pondfield cultivation as the preferred agricultural strategy due to higher yields, less investment of labour and the substantially superior social and economic return of wetland taro. This transference in the production economy would upset the balance of power as the relative abundance of wetland and dryland fields varied between polities.

12.0 CONCLUSION

The primary goal of this thesis is to investigate the role of monumental architecture in the long-term processes of sociopolitical evolution. The Oceanic island of Babeldaob in the Palau archipelago offers an ideal location to study the correlation in these developments due to the nature of its monumental earth structures. Monumental in both extent of built landscape and size of individual structures, Babeldaob's earthworks emerged close to a millennium earlier, and were abandoned several centuries before, the advent of monumentality on other Oceanic island groups and its re-establishment on Palau in the form of extensive stonework features. Babeldaob's earthworks form large conjoined clusters containing a multitude of morphological forms that performed simultaneous practical and symbolic functions.

The emphasis of the investigations was to identify the political economic strategies employed through time using the chronological, functional and spatial evidence embedded in architecture to trace the trajectory of sociopolitical development. The extent of Babeldaob's modified landscape calls for examining land use practices as adaptive strategies in a particular environment into the study. This also provided for an assessment of the scope of the energy and labour management practices invested in earthwork construction. These earthwork data sets allowed for presentation of a model of the process of the evolution of sociopolitical complexity during Babeldaob's Earthwork Era. In order to construct this model, analysis was undertaken at the landscape scale, the entire island of Babeldaob that incorporated both the district and community scales within the broader picture.

The underlying structure of the investigation was the dual-processual approach, the co-existing network and corporate political economic orientations chosen by emerging leaders to acquire and legitimize their power and prestige. Network strategies focus on personal aggrandization and hierarchical arrangements while corporate strategies emphasize group solidarity and interdependence through cohesive action. Distinguishing between corporate and network strategies is a heuristic tool for assessing the transformations in spatial dimensions, patterning and practical and ideological roles of Babeldaob's earth structures through time.

The leadership strategies rely on the interdependent political, ideological, ritual and particularly economic power sources to acquire authority and status.

12.1 The Earthwork Era Political Economy

The Earthwork Era political economy appears to be based on staple and ritual finance with the most valuable commodity the earthworks. Without evidence of long-distance trade of exotic goods contributing to the economy, the population may have been forced to rely on staple finance from the terrestrial and marine resource base, pottery vessels, and implements or decorative items fashioned from stone, shell and wood as their primary assets.

Kin-based groups and political alliances operated a trade network between neighbouring islands in the archipelago that was centred on internal capital. Babeldaob was likely exporting terrestrial foodstuffs, clay and stone resources and importing a variety of marine resources. Significant barter within Babeldaob may have been limited to unique ceramic vessels or fine-grained basalt adzes, only the former of which is found in high-status contexts. As the raw material sources of these latter goods are located throughout Babeldaob, their value can not be elevated by monopolizing the market.

A substantial long-term investment of energy, technological specialization and engineering expertise was devoted to the step-terrace, gully and basin complexes (Type IV) producing the staple production system. High yields would provide food security and the surplus goods used as the primary revenue for financing the activities of the emerging elite. Construction of the associated ritual, occupational and defensive earth architecture further increased the economic value of the built landscape.

These structures embodied a complex merger of energy investment, ancestral ties, ritual association, staple wealth and social bonding to become the most significant and valuable commodity in the Earthwork Era's political economy. As architecture, the earthwork landscape is a powerful conduit for institutionalizing belief systems, promoting social cohesion and allocating political economic control. Invested with ritual, ancestral, social and

economic meaning, the politicized landscape reinforces the prevailing ideology, reflects group identity and ancestral and traditional ties and advertises the wealth and prestige of the elite to legitimize and enhance their authority.

Authoritative resources and ritual finance were likely also an important source of wealth and power in the Earthwork Era. The emerging elite would have maintained strict control over the production, distribution and safekeeping of specialized knowledge, the ideology encoded in traditional narratives and ritual performances. This authority over the ritual economy sanctioned creating and manipulating the population's worldview and belief systems.

In this model, the financial base of Babeldaob's elite was the institutional ownership of the landesque capital, earthworks, surplus and authoritative resources. Tribute was in the form of labour, pottery vessels and marine and terrestrial foodstuffs. The creation, acquisition and maintenance of the built landscape played a significant role in Earthwork Era political economic strategies. As wealth, the earth structures symbolized the status, legitimacy and power of the polity and its rulers and their explicit rights to the staple goods.

12.2 A Monumental Earthwork Landscape

Spatial analysis of an extensive set of aerial photos combined with pedestrian survey identifies an estimated minimum of 20.4 percent (64 km²) of Babeldaob shaped into earth structures, despite 60 percent of the island being under forest cover and lacking survey. To have financed the engineering of this much of Babeldaob, emerging leaders perceived earthworks as an effective and persuasive tool in politicizing the landscape to transmit their ideology to the population. The discourse about power relations extended to the size of the structural components in the massive and morphologically varied complexes. Far larger than needed to perform any practical function, crowns measure up to 10 m high and step-terraces often rise over a meter. Construction fill deposits routinely total one to four meters thick. Many structures did not gain monumental status by accretion but were built in a single or double seasonal process.

This developmental model suggests that the limited coastal margin available for wetland cultivation and settlements was soon depleted by the growing population and the subsistence base moved inland. Initial levelling to produce flat activity areas was in response to the extent of Babeldaob's rolling topography and likely began almost immediately after colonization, perhaps by 3100 calBP. In itself, the island's steep slopes are not enough of an impetus to devote such a large expenditure of energy to step-terrace construction as many cultivation systems persist for centuries on similar topography. Given the high precipitation, the sloping land, and the instability and low native fertility of the highly weathered, heterogeneous and easily saturated soils covering over 80 percent of Babeldaob, development of step-terraces was an effective strategic choice to prevent land degradation and support a viable agricultural system.

These same environmental conditions ensured that construction of earth structures was labour intensive and required a thorough knowledge of soil mechanics, hydrogeological conditions and engineering principles. Trial and error resulted in carefully planned architectural designs with sophisticated construction techniques that incorporated water management and large-scale erosion control measures to minimize construction disasters, combat degradation and maintain soil fertility. Construction of immense earthwork complexes through cut and fill techniques was well underway by 1900 calBP.

The recognition of the complexity and vulnerability of construction and dryland agriculture in Babeldaob's particular edaphic and climatic conditions soon led to both activities being accompanied by ceremony and ritual. Earth structures dedicated to these performances binds staple finance to the dominant ideology. This ritualization identifies the significance of earthwork construction and cultivation to Earthwork Era society. The construction process, varied uses of structures, spatial patterning and dimensions embed meaning and symbolism into the highly visible built landscape.

The interior landscape was soon transformed to accommodate community infrastructure such as trails, water works, cultivated fields and meeting sites; habitation areas; ritual,

ceremonial and elite structures; and defensive sites including barriers, signal towers, places of refuge, boundary markers and sentry posts. Distributed into ten large clusters of contiguous modified terrain, the earthworks define territorial units to legitimize corporate claims of land and other resources and create defensible terrain.

The investment of labour in earthworks as public works may not have followed the trajectory of sociopolitical development that shifted from smaller to larger political structures. It appears that a significant proportion of the large complexes were constructed by allied chiefdoms earlier rather than later in the Earthwork Era. Once integrated into decentralized polities, new construction may have been devoted to maintenance, restructuring crowns and building perimeter boundary markers and defensive features. At the end of the Earthwork Era, new but smaller and less elaborate structures were built in the buffer zone outside of the old polities and smaller elements such as knobs on crowns were added to pre-existing crowns.

The intent of the first earthworks was likely entirely utilitarian and associated with the basic subsistence economy rather than with the explicit objective of producing surplus. With the key element in Palau's political economy being the landesque capital and accompanying earth architecture, underlying the trajectory of Earthwork Era sociopolitical complexity is the rain-fed step-terrace agricultural systems that provided surplus for the emerging elite. Babeldaob's societal transformations were equally reliant on the substantive power base afforded by ideology, also contained in the earthworks. Economic production, ideological systems and military power were mutually supportive in the Earthwork Era.

12.3 Signatures of Leadership Strategies

Babeldaob's sociopolitical organization is modelled to have developed from somewhat heterarchical kin groups, to competitive chiefdoms, to rival decentralized polities. Corporate and network political economic strategies fused to maintain a level playing field in what could be a volatile sociopolitical situation. With a staple economy based on land, labour and the production of surplus, corporate leadership strategies prevailed. However, rival factions and competing polities were extremely dynamic as they manoeuvred for prestige and wealth

through alliances and warfare based in a network orientation. By the end of the Earthwork Era there is a clear expression of economic stratification and personal aggrandization.

The model suggests that initially the small kin groups had low levels of political interaction. Based on both cooperation and status rivalry, neighbouring kin groups soon formed corporate-based chiefdoms where power may have been shared among clan leaders. It became economically and militarily productive for small chiefdoms to join into competing territorially circumscribed units administered by a loosely ranked council of chiefs. Each chiefdom retained control over its agricultural production and land tenure system. Conflict between the fragile alliances of chiefdoms was mitigated by the ruling council. Ultimately, the chiefdoms became more stratified based on ownership of earthworks that provided them with ideological wealth, military power and control of surplus production.

The extent of Babeldaob's earthworks suggests that the multi-faceted monumental construction events involving communal construction, ritual events and feasting was the primary corporate leadership strategy. Ritual vessel deposition beneath earthwork structures suggests communal offerings to construction gods although the ritual behaviour may be in honour of the individual financing the earthwork structure. Once built, these structures remained on the landscape to memorialize participation in the shared experience and reinforce community tradition.

Corporate leadership strategies are evident in the structured communal graveyards identifying the emphasis on kin groups or specific lineages and the generic supernatural themes found in the monolithic carved stone faces scattered across Babeldaob. Also integrating groups and enhancing social relations are the fertility rituals in highly visible crown cultivation basins. The produce may have been used as offerings to sanctify the demi-gods and the ceremonial act itself.

Contrary to enabling community visibility, these rituals on crown summits may signify network leadership strategies of exclusion and monumentality, especially if the plants were for the consumption or use by the upper class. Also concomitant with a corporate orientation are

exclusionary strategies of socially significant, high status or ceremonial centres containing evidence of craft specialization established on earthworks by at least 2200 calBP.

The distinct multimodal settlement pattern reflects hierarchically organized competitive districts. Rivalry between polities, and perhaps chiefdoms, is expressed in the monumental size of earthwork complexes. This advocates for the value of earth architecture in acquiring and manipulating military power through symbolic posturing and defensive strategies. Massive earthworks constructed by at least 1900 calBP may be in response to the development of competing neighbouring chiefdoms manoeuvring for more prestige early in the sequence.

Within this network inter-polity settlement pattern, corporate strategies are expressed in the most prominent and impressive constructed elements strategically placed to be more visible to rival polities rather than their own population. Corporate strategies, and decentralized complexity, are suggested within polities by the lack of a dominant central earthwork, a closed architectural group or a large nucleated community and the frequency of open unstructured spaces able to accommodate large public assemblies. The small surface, ring-ditches and high vertical slopes of crowns identifies their summits as the single prominent exclusionary space.

Other intra-district network strategies include defensive ditches and artificial steep, high sides restricting large earthwork surfaces to a particular segment of society, likely the kin unit who inhabited them. Crowns as surveillance posts inside districts might indicate monitoring of chiefdom or district populations. It is possible that authoritative resources and the structuring of ritual developed into a powerful measure of intra-polity social control. These exclusionary strategies worked to re-define the faction-based authority into the overlay of the larger territorial political structure.

Personal aggrandization only occurs in the Late Phase of the Earthwork Era when prominent crowns contain structured burials of high-ranking individuals. Iconography may begin to depict individual political figures, a network strategy. The effort devoted to the

defensive role of complexes also indicates that the scale of warfare (or at least the threat of attack) was substantially greater in this period.

12.5 Problems and Future Work in Modelling the Earthwork Era

Earthwork Era archaeological investigations have only begun in earnest in the past decade leaving substantial gaps in radiometric data and area of coverage. This lack of contextualization in which to interpret the structures is a significant issue in distinguishing corporate versus network political economic strategies in the Earthwork Era. Contextualizing a culture to better examine the leadership strategies employed in the evolution of complexity requires a data-rich environment (Small 2009). This is afforded by a combination of material remains, traditional and historical narratives, an understanding of localized environmental conditions and a relatively fine-grained chronology. Furthermore, Small (2009:207) states that:

the application of the dual-processual model must isolate specific institutional contexts, their correlation to material culture, their relationship to one another within a specified culture, and their role in social change.

Almost 30 years ago, Gumerman (1986) determined that knowledge of Palau's cultural history was not at the stage where changing relationships between social hierarchies and warfare or alliances, demographics and a scarcity of resources could be detected. Although Snyder et al. (2011) suggest this is still the case, a model of the cultural sequence of Earthwork Era Palau needs to be developed to provide a foundation for forming relevant research questions as earthwork investigations continue to progress.

A concern with applying the dual-processual framework to the Earthwork Era is the almost complete lack of traditional narratives associated with Babeldaob's terrace structures. The lack of oral traditions about Earthwork Era remains and the time period in general is interpreted by Liston and Miko (2011) as signifying a transformation in sociopolitical organization that is also evident in the switch in settlement patterns and subsistence regimes. Unlike the majority of monumental architecture or other substantial anthropogenic remains in the Pacific, there is no context for Babeldaob's earthworks beyond the archaeological

information. This can result in substantial variability in interpretations. As stated by Small (2009) when examining Greek monumental architecture in a dual-processual framework:

Without this type of data, we would have missed this important feature in the “corporate” assembly of the Prienians entirely, and would have assumed that the rather egalitarian nature of the seating would have signaled that the context held only a corporate ideology. [Small 2009:217]

A second concern in examining Earthwork Era leadership strategies is the limited data sets due to the lack of preservation of faunal material, botanical remains, human burials or other organic remains in the acidic soils. This eliminates or severely diminishes the possibility of distinguishing long-distance trade networks, the subsistence economy, feasting activities and human disease and trauma, among many other behavioural patterns. Data on material remains largely relies on what can be gleaned from those ceramics that have not been redistributed in construction sequences or used as grog, the rather minimal lithic assemblage, and the cultural remains unearthed in Rock Island and limestone cave deposits. In the latter case there is a likely disparity between contemporaneous Babeldaob and Rock Island assemblages due to variable exchange patterns and a distinct or narrower range of activities on the smaller islands.

Identification of the transformations in sociopolitical organization during the Earthwork Era is seriously hampered by lack of chronological data. In large part, the dual-processual approach assumes that structural size and elaboration is relative to the rank of the user and the importance of the activity and that spatial arrangements reflect land tenure systems and the relationships between individuals and groups. Distinguishing temporal variations between district extent and components, earthwork form and function, distributional patterning, and historical succession requires considerably more chronological information. A substantial corpus of radiometric determinations is needed from all the earthwork districts, but especially Aimeliik and the stonework villages located on lowland earthwork complexes. These assays will define the events that transpired between the Earthwork and Stonework Eras so that the processes in and nature of the shift in socioeconomic focus from the interior to the coast can be understood.

Future research in Babeldaob's earthwork complexes has enormous potential for contributing to the understanding of the emergence of monumental architecture and the development of sociopolitical complexity in Palau. Addressing these processes provides insight into the variability inherent to Oceanic sociopolitical structure and organization. The most productive method for exploring these avenues of research is with multidisciplinary evidence that draws on archaeology, palaeoecology, ethnology, remote sensing and demography.

Diligent efforts at reconstructing Earthwork Era demographics is an important future research topic to assist in assessing and interpreting the archaeological data and proposing models for culture change. Paleoclimate studies can recognize shifts in Micronesia's climate and weather patterns that may have resulted in environmental stress during the Earthwork Era. High-resolution paleoecological investigations are needed to identify the changing landforms and archaeobotanical remains in the wetlands below step-terrace systems and in interior wetland basins. This will verify the use of step-terraces as agricultural, identify the crops grown for subsistence and in ritual activities, provide radiometric assays of interior cultivation, reconstruct the interior vegetation patterns, and assist in modelling coastal transformations. Wide-band synthetic-aperture radar (SARS) capable of revealing sub-meter resolution of the topography beneath the forest canopy allows for a rapid and accurate method of surveying the 180 km² of forested land yet to be archaeologically investigated. These images can identify the extent, patterned distribution, size and form of the earthworks and allow for development of 3D models useful for long-term management of the Pacific's oldest monumental architecture.

REFERENCES

- Abrams, E. 1989. Architecture and energy: An evolutionary perspective. *Archaeological Method and Theory* 1:47-87.
- Abrams, E.M. and T.W. Bolland. 1999. Architectural energetics, ancient monuments, and operations management. *Journal of Archaeological Method and Theory* 6(4):263-291.
- Allen, J. 1991. The role of agriculture in the evolution of the pre-contact Hawaiian state. *Asian Perspectives* 30:117-132.
- Allen, M.S. 2004. Bet-hedging strategies, agricultural change, and unpredictable environments: Historical development of dryland agriculture in Kona. *Journal of Anthropological Archaeology* 23:196-224.
- Allen, M.S. 2006. New ideas about late Holocene climate variability in the central Pacific. *Current Anthropology* 47(3):521-535.
- Allen, M.S. 2010. Oscillating climate and socio-political process: the case of the Marquesan Chiefdom, Polynesia. *Antiquity* 84(323):86-102.
- Allen, M.W. 1994. *Warfare and Economic Power in Simple Chiefdoms: The Development of Fortified Villages and Polities in Mid-Hawkes Bay, New Zealand*. Unpublished PhD Dissertation, Department of Anthropology, University of California, Los Angeles.
- Anderson A. 1991. The chronology of colonization in New Zealand. *Antiquity* 65:767-95.
- Anschuetz, K.R., R.H. Wilshusen, and C.L. Scheick. 2001. An archaeology of landscapes: Perspectives and directions. *Journal of Archaeological Research* 9(2):157-311.
- April, V. and J. Pantaleo. 2002. *Archaeological Inventory Survey of the Proposed Rock Quarry Ngedesaker, Ngeremlengui State, Republic of Palau*. Prepared for Jess T. Lizama & Associates, Inc. Palau Cultural and Environmental Resource Management.
- Aranyosi, E.F. 1999. Wasteful advertising and variance reduction: Darwinian models for the significance of non-utilitarian architecture. *Journal of Anthropological Archaeology* 18:356-375.
- Aswani, S. and M. Graves. 1998. The Tongan maritime expansion: A case in the evolutionary ecology of social complexity. *Asian Perspectives* 37(2):135-164.
- Athens, J.S. 1997. Hawaiian native lowland vegetation in prehistory. In *Historical Ecology in the Pacific Islands: Prehistoric Environmental and Landscape Change*, edited by P.V. Kirch and T.L. Hunt, pp. 248-270. Yale University Press, New Haven, Connecticut.
- Athens, J.S. 2011. Paleoenvironmental Contributions. In *Archaeological Monitoring and Emergency Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume XII: Lab Analyses, Discussion, Syntheses*, edited by J. Liston, pp. 521-524. Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.
- Athens, J.S., M.F. Dega, and J.V. Ward. 2004. Austronesian colonisation of the Mariana islands: The palaeoenvironmental evidence. *Indo-Pacific Prehistory Association Bulletin* 24(2):21-30.

Athens, J.S., R.L. Hunter-Anderson, J.V. Ward, and D.J. Welch. 1989. Landscape change, agriculture, and complex societies on tropical Pacific Islands. *Reprint Proceedings of the Circum-Pacific Prehistory Conference*, Volume 4, pp. 1-34. Seattle, Washington.

Athens, J.S. and J. Stevenson. 2011. Holocene paleoenvironmental investigations. In *Archaeological Monitoring and Emergency Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume XII: Lab Analyses, Discussion, Syntheses*, edited by J. Liston and M.J. Tomori-Tuggle. Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Athens, J.S. and J. Stevenson. 2012. Pohnpei coring records: the natural distribution of *Cyrtosperma chamissonis*. *Journal of Pacific Archaeology* 3(1):35-48.

Athens, J.S. and J.V. Ward. 1998. *Paleoenvironment and Prehistoric Landscape Change: A Sediment Core Record from Lake Hagoi, Tinian, CNMI*. Prepared for the Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawai'i under contract to Belt Collins Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Athens, J.S. and J.V. Ward. 2001. Paleoenvironmental evidence for early human settlement in Palau: The Ngerchau core. In *Pacific 2000: Proceedings of the Fifth International Conference on Easter Island and the Pacific*, edited by C.M. Stevenson and F.J. Morin, pp 165-178. Easter Island Foundation, Los Osos, California.

Athens, J.S. and J.V. Ward. 2002. *Holocene Paleoenvironmental Investigations on Ngerekebesang, Koror, South Babeldaob, and Peleliu Islands, Palau*. Prepared for Palau National Communications Corporation, Republic of Palau. International Archaeological Research Institute, Inc., Honolulu.

Athens, J. S. and J.V. Ward. 2004. Holocene vegetation, savanna origins and human settlement of Guam. In: *A Pacific Odyssey: Archaeology and Anthropology in the Western Pacific. Papers in Honour of Jim Specht*, edited by V. Attenbrow and R. Fullagar. pp. 15-30. Records of the Australian Museum, Supplement 29, Sydney.

Athens, J.S. and J.V. Ward. 2005. *Compact Road Archaeological Investigations, Babeldaob Island, Palau. Volume IV: The Holocene Paleoenvironment of Palau*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Athens, J.S., J.V. Ward, and G.M. Murakami. 1996. Development of an agroforest on a Micronesian high island: Prehistoric Kosraean agriculture. *Antiquity* 70:834-846.

Aydin, A. 2006. Stability of saprolitic slopes: nature and role of field scale heterogeneities. *Natural Hazards and Earth System Sciences* 6:89-96.

AusAID. 2006. *Sea Level and Climate: Their Present State Palau*. Australian Agency for International Development. <http://www.sprep.org/att/IRC/eCOPIES/Countries/Palau/4.pdf>. Accessed June 2009.

Balée, W. 1998. Historical ecology: Premises and postulates. In *Advances in Historical Ecology*, edited by W. Balée, pp. 13-29. Columbia University Press, New York.

Balée, W. 2006. The research program of historical ecology. *Annual Review of Anthropology* 35:75-98.

Barrau, J. 1961. *Subsistence Agriculture in Polynesia and Micronesia*. B.P. Bishop Museum Bulletin 223, Bishop Museum Press, Honolulu.

Basilius, U. 2002. Ngchesar oral history. In *Archaeological survey, monitoring, oral history of bore holes, rock quarries and coral dredging locations for the Compact Road, Babeldaob Island, Republic of Palau*, by J. Liston, J. Tellei, U. Basilius, and F.K. Rehuher, pp. 141-151. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Bath, J. and J.S. Athens. 1990. Prehistoric social complexity on Pohnpei: The Saudeleur to Nahnmwarki Transition. In *Recent Advances in Micronesian Archaeology, Micronesia, Supplement 2*, edited by R.L. Hunter-Anderson, pp. 275-290. University of Guam Press, Mangilao.

Bayliss-Smith, T., E. Hviding and T. Whitmore. 2003. Rainforest composition and histories of human disturbance in Solomon Islands. *AMBIO: A Journal of the Human Environment* 32(5):346-352.

Beardsley, F. 1997. *Fishponds, Taro Patches and Shell Middens: Archaeological Investigations on Peleliu, Republic of Palau, Data Recovery and Monitoring for the Palau Rural Water System Program*. Prepared for Winzler and Kelly, Consulting Engineers, Republic of Palau. International Archaeological Research Institute, Inc., Honolulu.

Beardsley, F.R. and U. Basilius. 2002. Sengall Ridge, Belau: burials, spirit walks and painted pottery. In *The Melaka papers: Proceedings of the 16th Congress of the Indo-Pacific Prehistory Association, Melaka, Malaysia, 1 to 7 July 1998*. *Bulletin of the Indo-Pacific Prehistory Association*, 22(6):147-151.

Bernardini, W. 2004. Hopewell geometric earthworks: A case study in the referential and experiential meaning of monuments. *Journal of Anthropological Archaeology* 23(3):331-356.

Best, S. 1993. At the halls of the mountain kings. Fijian and Samoan fortifications: comparison and analysis. *Journal of the Polynesian Society* 102(4):385-447.

Binford, L.R. 1971. Mortuary practices: their study and their potential. *Memoirs of the Society for American Archaeology* 25:6-29.

Bintliff, J. 1999. Settlement and territory. In *Companion Encyclopedia of Archaeology*, edited by G. Barker and A. Grant, pp. 505-545. Routledge, London.

Blaikie, P. and H.C. Brookfield. 1987. *Land Degradation and Society*. Methuen, London.

Blanton, R.E. 1998. Beyond centralization: steps toward a theory of egalitarian behavior in archaic states. In *Archaic States*, edited by G. Feinman and J. Marcus, pp. 135-172. School of American Research Advanced Seminar Series. School of American Research, Santa Fe, New Mexico.

Blanton, R.E., G.M. Feinman, S.A. Kowalewski and P.N. Peregrine. 1996. A dual-processual theory for the evolution of Mesoamerican civilization. *Current Anthropology* 37:1-31.

Blaiyok, K.V. and W.R. Metes. 1985. *Archaeological Reconnaissance Survey Report of Melekeok State, Republic of Palau*. Division of Cultural Affairs, Republic of Palau.

Blaiyok, V.K., W.R. Metes, S. Ngeringeschei and T. Remasch. 1986. *An Archaeological Survey Report on the Paving of Ngeremlengui Road and Water Distribution System Ngeremlengui State, Republic of Palau*. Division of Cultural Affairs, Republic of Palau.

- Blitz, J. and P. Livingood. 2004. Sociopolitical implications of Mississippian mound volume. *American Antiquity* 69(2):291-301.
- Bondarenko, D.M., L.E. Grinin and A.V. Korotayev. 2002. Alternative pathways of social evolution. *Social Evolution & History* 1(1):54-79.
- Boone, J.L. 1992. Competition, conflict, and the development of social hierarchies. In *Evolutionary Ecology and Human Behavior*, edited by E.A. Smith and B. Winterhalder, pp. 301-337. Aldine de Gruyter, New York.
- Boserup, E. 1965. *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. Aldine, Chicago.
- Bronk Ramsey, C. 2005. OxCal Program v 3.10. Oxford: University of Oxford Radiocarbon Unit. <http://www.rlaha.ox.ac.uk/oxcal/oxcal.htm>
- Brookfield, H.C. 1972. Intensification and disintensification in Pacific agriculture: a theoretical approach. *Pacific Viewpoint* 13:30-48.
- Brookfield, H.C. 1984. Intensification revisited. *Pacific Viewpoint* 25:15-44.
- Brumfiel, E.M. 1994. Factional competition and political development in the New World: an introduction. In *Factional Competition and Political Development in the New World*, edited by E.M. Brumfiel and J.W. Fox, pp. 3-13. Cambridge University Press, Cambridge.
- Bruno, J., C. Siddon, J. Witman, P. Colin and M. Toscano. 2001. El Niño related coral bleaching in Palau, western Caroline Islands. *Coral Reefs* 20(2):127-136.
- Burley, D.V. 1998. Monumental architecture and the use of stone in the classical Tongan chiefdom. In *Easter Island in Pacific Context, South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, edited by C.M. Stevenson, G. Lee and F.J. Morin, pp. 320-325. Easter Island Foundation, Los Osos, California.
- Butler, B.M. 1984. *A Preliminary Report on the 1983 Archaeological Survey of Aimeliik State, Republic of Palau*. Prepared for Belau National Museum, Inc., Ministry of Social Services Division of Cultural Affairs, Republic of Palau. Center for Archaeological Investigations, Southern Illinois University, Carbondale.
- Carucci, J. 1992. *Cultural and natural patterning in prehistoric marine foodshell from Palau, Micronesia*. Unpublished PhD Dissertation, Department of Anthropology, Southern Illinois University, Carbondale.
- Carneiro, R. 1970. A theory of the origin of the state: traditional theories of state origins are considered and rejected in favor of a new ecological hypothesis. *Science* 169(3947):773-783.
- Clark, G.R. 2005. A 3000-year culture sequence from Palau, Western Micronesia. *Asian Perspectives* 44(2):349-380.
- Clark, G.R. and H. Martinsson-Wallin. 2007. Monumental architecture in West Polynesia: origins, chiefs, and archaeological approaches. *Archaeology in Oceania* 42, Supplement:28-40.
- Clark, G.R. and C. Reepmeyer. 2012. Last millennium climate change in the occupation and abandonment of Palau's Rock Islands. *Archaeology in Oceania* 47:29-38.

Clark, G.R. and D. Wright. 2007. Reading Pacific pots. In *Vastly Ingenious: The Archaeology of Pacific Material Culture in Honour of Janet M. Davidson*, edited by A. Anderson, K. Green, and F. Leach, pp. 173-189. Otago University Press, New Zealand.

Clarke, W.C. and R.R. Thaman (editors). 1993. *Agroforestry in the Pacific Islands: Systems for Sustainability*. United Nations University Press, Tokyo, Japan.

Cliggett, L. and C.A. Poole. (editors). 2008. *Economies and the Transformation of Landscape*. Altamira Press, New York.

Cochrane, E.E., R. Shalk, T.M. Rieth, M. Desilets, D. Grant, J. Liston and I. Carlson. 2005. *Archaeological Testing and Monitoring for the Palau National Communication Corporation in Angaur, Babeldaob, Kayangel, and Peleliu, Republic of Palau*. Draft report prepared for Palau National Communications Corporation, Koror. International Archaeological Research Institute, Inc., Honolulu.

Cole, T.G., M.C. Falanruw, C. MacLean, C.D. Whitesell and A.H. Ambacher. 1987. *Vegetation Survey of the Republic of Palau*. Resource Bulletin PSW-22. Pacific Southwest Forest and Range Experiment, Forest Service, U.S. Department of Agriculture.

Colin, P.L. 2009. *Marine Environments of Palau*. Coral Reef Research Foundation, Koror, Palau.

Cordy, R. 1981. *A Study of Prehistoric Social Change. The Development of Complex Societies in the Hawaiian Islands*. Academic Press, New York.

Corwin, G., C.L. Rogers and P.O. Elmquist. 1956. *Military Geology of Palau Islands, Caroline Islands*. Headquarters U.S. Army Forces Far East, Intelligence Division, Office of the Engineer.

Costin, C. and T. Earle. 1989. Status distinction and legitimization of power as reflected in changing patterns of consumption in Late Prehispanic Peru. *Latin American Antiquity* 54:691-714.

Costion, C., A.H. Kitalong and T. Holm. 2009. Plant endemism, rarity, and threat in Palau, Micronesia: a geographical checklist and preliminary red list assessment. *Micronesica* 41(1):131-164.

Costion, C., J. Liston, A. Kitalong and A. Iida. 2012. Using the ancient past for establishing current threat in poorly inventoried regions. *Biological Conservation* 147(1):153-162.

Costion, C. and D. Lorence. 2012. The endemic plants of Micronesia: a geographical checklist and commentary. *Micronesica* 43(1):51-100.

Crumley, C.L. 1987. A dialectical critique of hierarchy. In *Power Relations and State Formation*, edited by T.C. Patterson and C.W. Gailey, pp. 155-169. American Anthropological Association, Washington D.C.

Crumley, C.L. 1994. Historical ecology: A multidimensional ecological orientation. In *Historical Ecology: Cultural Knowledge and Changing Landscapes*, edited by C.L. Crumley, pp. 1-17. School of American Research Press. Santa Fe.

Crumley, C.L. 1995. Heterarchy and the analysis of complex societies. In *Heterarchy and the Analysis of Complex Societies*, edited by R.M. Ehrenreich, C.L. Crumley and J.E. Levy, pp. 1-5. Archaeological Papers of the American Anthropological Association, No. 6. American Anthropological Association, Arlington.

- Crumley, C.L. 2007. Historical ecology: integrated thinking at multiple temporal and spatial scales. In *The World System and the Earth System: Global Socioenvironmental Change and Sustainability Since the Neolithic*, edited by A. Hornberg and C. Crumley, pp. 15-28. Left Coast Press, Walnut Creek, California.
- D'Altroy, T. and T. Earle. 1985. Staple finance, wealth finance, and storage in the Inka political economy. *Current Anthropology* 26:187-206
- De Langhe, E., L. Vrydaghs, P. deMaret, X. Perrier and T. Denham. 2009. Why bananas matter: an introduction to the history of banana domestication. *Ethnobotany Research and Applications* 7:165-177.
- del Rosario, A.G. and N.M. Esguerra. 2003. *Crop Profile for Colocasia Taro in the Republic of Palau*. Palau Community College, Cooperative Research and Extension Publication 27/03 (3.0C), Koror, Republic of Palau.
- DeMarrais, E., L.J. Castillo and T. Earle. 1996. Ideology, materialization, and power strategies. *Current Anthropology* 37(1):15-31.
- de Montmollin, O. 1989. *The Archaeology of Political Structure: Settlement Analysis in a Classic Maya Polity*. Cambridge University Press, Cambridge.
- Desilets, M., J. Liston and H.D. Tuggle. 2007. Ceramic analysis. In *Archaeological Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Volume V: Lab Analysis, Synthesis, and Recommendations*, edited by M.J. Tomanari-Tuggle, H.D. Tuggle, and J. Liston, pp. 181-230. Prepared for the U.S. Army Engineer District, Honolulu, Ft. Shafter, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.
- Dickinson, W.R. and J.S. Athens. 2007. Holocene paleoshoreline and paleoenvironmental history of Palau: Implications for human settlement. *Journal of Island and Coastal Archaeology* 2(2):175-196.
- Dietler, M. and B. Hayden. 2010. Digesting the feast—good to eat, good to drink, good to think: an introduction. In *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, edited by M. Dietler and B. Hayden, pp. 1-20. University of Alabama Press, Tuscaloosa, Alabama. (Reprint).
- Dobres, M.A. and J. Robb (editors). 2000. *Agency in Archaeology*. Routledge, London.
- Donnegan, J.A., S.L. Butler, O. Kuegler, B.J. Stroud, B.A. Hiserote and K. Rengulbai. 2007. *Palau's Forest Resources, 2003*. Resource Bulletin PNW-RB-252, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon.
- Doolittle, W. 1984. Agricultural change as incremental process. *Annals of the Association of American Geographers* 74:124-137.
- Drennan, R. and C. Peterson. 2006. Patterned variation in prehistoric chiefdoms. *Proceedings of the National Academy of Sciences of the United States of America* 103(11):3960-3967.
- Dunnell, R.C. 1989. Aspects of the application of evolutionary theory in archaeology. In *Archaeological Thought in the Americas*, edited by C.C. Lamberg-Karlovsky, pp. 35-49. Cambridge University Press, Cambridge.
- Dunnell, R.C. 1999. The concept of waste in evolutionary archaeology. *Journal of Anthropological Archaeology* 18:243-250.

- Dunnell, R.C. and W.S. Dancey. 1983. The siteless survey: a regional scale data collection strategy. *Advances in Archaeological Method and Theory* 6:267-287.
- Dunning, N. and T. Beach. 1994. Soil erosion, slope management, and ancient terracing in the Maya lowlands. *Latin American Antiquity* 5(1):51-69.
- Earle, T. 1978. Economic and social organization of a complex chiefdom: the Halelea district, Kaua'i, Hawaii. In *University of Michigan Anthropological Papers No. 63*, pp. 1-205. Museum of Anthropology, University of Michigan Press, Ann Arbor.
- Earle, T. 1987. Chiefdoms in archaeological and ethnohistorical perspective. *Annual Review of Anthropology* 16:279-308.
- Earle, T. 1991a. The evolution of chiefdoms. In *Chiefdoms: Power, Economy, and Society*, edited by T. Earle, pp. 1-15. Cambridge University Press, Cambridge.
- Earle, T. 1991b. Property rights and the evolution of chiefdoms. In *Chiefdoms: Power, Economy, and Society*, edited by T. Earle, pp. 71-99. Cambridge University Press, Cambridge.
- Earle, T. 1997. *How Chiefs Come to Power: The Political Economy in Prehistory*. Stanford University Press, Stanford, California.
- Earle, T. 2000. Archaeology, property, and prehistory. *Annual Review of Anthropology* 29(1):39-60.
- Earle, T. 2002. Commodity flows and the evolution of complex societies. *Theory in Economic Anthropology*, edited by J. Ensminger, pp. 81-103. AltaMira Press, Walnut Creek, California.
- Earle, T. and D.E. Doyel. 2008 The engineered landscapes of irrigation. In *Economies and the Transformation of Landscape*, edited by L. Cliggett and C.A. Poole, pp. 19-46. AltaMira Press, New York.
- Easton, W.H. and T. Ku. 1980. Holocene sea-level changes in Palau, West Caroline Islands. *Quaternary Research* 14:199-209.
- Englehardt, J.D. and D.M. Nagle. 2011. Variations on a theme: dual-processual theory and the foreign impact on Mycenaean and classic Maya architecture. *American Journal of Archaeology* 115(3):355-382.
- Erasmus, J. 1965. Monument building: some field experiments. *Southwestern Journal of Anthropology* 21(4):277-301.
- Erickson, C.L. 1993. The social organization of prehispanic raised field agriculture in the Lake Titicaca Basin. In *Economic Aspects of Water Management in the Prehistoric New World*, edited by V. Scarborough and B. Isaacs, pp. 369-426. Research in Economic Anthropology, Supplement 7, Greenwich, Connecticut.
- Erickson, C.L. 2006. Intensification, political economy, and the farming community: in defence of a bottom-up perspective of the past. In *Agricultural Strategies*, edited by J. Marcus and C. Stanish, pp. 334-363. Cotsen Institute of Archaeology, University of California, Los Angeles.
- Erickson, C.L. 2010. The transformation of environment into landscape: the historical ecology of monumental earthwork construction in the Bolivian Amazon. *Diversity* 2(4):618-652.
- Erickson, C.L. and J.H. Walker. 2009. Pre-columbian causeways and canals as landesque capital. In *Landscapes of Movement: Trails, Paths, and Roads in Anthropological Perspective*,

edited by J.E. Snead, C.L. Erickson and A. Darling, pp. 232-252. Penn Museum Press and University of Pennsylvania Press, Philadelphia.

Fargher, L.F., V.Y. Heredia-Espinoza and R.E. Blanton. 2011. Alternative pathways to power in late Postclassic Highland Mesoamerica. *Journal of Anthropological Archaeology* 30(3):306-326.

Feinman, G.M. 1995. The emergence of inequality: a focus on strategies and processes. In *Foundations of Social Inequality*, edited by T.D. Price and G.M. Feinman, pp. 255-279. Plenum Press, New York.

Feinman, G.M. 2000a. Duel-processual theory and social formations in the Southwest. In *Alternative Leadership Strategies in Prehispanic Southwest*, edited by B. Mills, pp. 207-224. University of Arizona Press, Tucson.

Feinman, G.M. 2000b. Corporate/network: new perspectives on models of political action and the Puebloan Southwest. *Social Theory in Archaeology*, edited by M.B. Schiffer, pp. 31-51. University of Utah Press, Salt Lake City.

Feinman, G.M. 2001. Mesoamerican political complexity. In *From Leaders to Rulers*, edited by J. Haas, pp. 151-175. Plenum Publishers, New York.

Feinman, G.M., K.G. Lightfoot and S. Upham. 2000. Political hierarchies and organizational strategies in the Puebloan Southwest. *American Antiquity* 65:449-470.

Ferguson, R.B. 1997. Violence and war in prehistory. In *Troubled Times: Violence and Warfare in the Past*, edited by D. Martin and D. Frayer, pp. 321-353. War in Society, Volume 3. Gordon and Breach Publishers, Amsterdam.

Field, J.S. 1998. Natural and constructed defenses in Fijian fortifications. *Asian Perspectives* 37:32-58.

Field J.S. 2004. Environmental and climatic considerations: a hypothesis for conflict and the emergence of social complexity in Fijian prehistory. *Journal of Anthropological Archaeology* 23:79-99.

Field, J.S. and P.V. Lape. 2010. Paleoclimates and the emergence of fortifications in the tropical Pacific islands. *Journal of Anthropological Archaeology* 29(1):113-124.

Firth, R. 1965 [1939]. *Primitive Polynesian Economy*. Routledge, London.

Fisher, C., H. Pollard and C. Frederick. 1999. Intensive agriculture and socio-political development in the Lake Pátzcuaro Basin, Michoacán, Mexico. *Antiquity* 73(281):642-649.

Fitzpatrick, S.M. 2003. Shellfish assemblages from two limestone quarries in the Palau Islands. *Journal of Ethnobiology* 23(1):101-123.

Fitzpatrick, S.M. 2010. A critique of the 'AD 1300 Event', with particular reference to Palau. *Journal of Pacific Archaeology* 1(2):168-173.

Fitzpatrick, S.M. 2011. Defending the defensible or offending the sensible? A response to Nunn & Hunter-Anderson. *Journal of Pacific Archaeology* 2(1):100-105.

Fitzpatrick, S.M. and O. Kataoka. 2005. Prehistoric fishing in Palau, Micronesia: evidence from the northern Rock Islands. *Archaeology in Oceania* 40:1-13.

- Flenley, J.R. 1994. Pollen in Polynesia: the use of palynology to detect human activity in the Pacific islands. *Tropical Archaeobotany: Applications and New Developments* 22:202.
- Force, R. 1960. *Leadership and Cultural Change in Palau*. Fieldiana: Anthropology No. 50, Chicago Natural History Museum, Chicago.
- Fosberg, F.R., M.H. Sachet and R.L. Oliver. 1987. A geographical checklist of the Micronesian Monocotyledonae. *Micronesica* 20(1-2):19-130.
- Fried, M.H. 1967. *The Evolution of Political Society: An Essay in Political Anthropology*. Random House, New York.
- Gagan M.K., E.J. Hendy, S.G. Haberle and W.S. Hantoro. 2004. Post-glacial evolution of the Indo-Pacific warm pool and El Niño Southern Oscillation. *Quaternary International* 118:127-143.
- Gavenda, R.T., A.H. Ingersoll, S.L. White, N. Caruso, R.A. DeMeo, P. Zellmer and J.H. Lawrence. 2005. *Ngerikiil Watershed Resource Assessment*. U.S. Department of Agriculture, Natural Resources Conservation Service, Pacific Basin Area. Mongmong, Guam.
- Gavenda, R. and J. Nemecek. 2006. *Soil Quality and Land Use Change on a Humid Tropical Island – Palau*. Poster presented at the 18th World Congress of Soil Science. July 9-15, 2006. Philadelphia, Pennsylvania.
- Golbuu, Y., S. Victor, E. Wolanski and R.H. Richmond. 2003. Trapping of fine sediment in a semi-enclosed bay, Palau, Micronesia. *Estuarine, Coastal and Shelf Science*, 57(5):941-949.
- Golbuu, Y., E. Wolanski, P. Harrison, R. Richmond, S. Victor and K. Fabricius. 2011. Effects of land-use change on characteristics and dynamics of watershed discharges in Babeldaob, Palau, Micronesia. *Journal of Marine Biology* pp. 1-17.
- Goldman, I. 1955. Status rivalry and cultural evolution in Polynesia. *American Anthropologist* 57(4):680-697.
- Graves, M.W. and T.N. Lidefeged. 1995. The evolutionary significance of ceremonial architecture in Polynesia. In *Evolutionary Archaeology: Methodological Approaches*, edited by P.A. Teltser, pp. 149–174. University of Arizona Press, Tucson.
- Graves, M.W. and M. Sweeney. 1993. Ritual behaviour and ceremonial structures in Eastern Polynesia: changing perspectives on archaeological variability. In *The Evolution and Organisation of Prehistoric Society in Polynesia*, editors M.W. Graves and R.E. Green, pp. 106-125. New Zealand Archaeological Association, Monograph No. 19, Auckland.
- Green R.C. 1993. Tropical Polynesian prehistory - where are we now? In *A Community of Culture: The People and Prehistory of the Pacific*, edited by M. Spriggs, D. E. Yen, W. Ambrose, R. Jones, A. Thorne and A. Andrews, pp. 218-238. Occasional Papers in Prehistory, No 21, Australian National University, Canberra.
- Green, R.C. 2002. A retrospective view of settlement pattern studies in Samoa. In *Pacific Landscapes. Archaeological Approaches*, edited by T.N. Lidefeged and M.W. Graves, pp. 125-152. Easter Island Foundation, Bearsville Press, Los Osos, California.
- Groube, L. 1970. The origin and development of earthwork fortifications in the Pacific. In *Studies in Oceanic Culture History, Volume 1*, edited by R.C. Green and M. Kelly, pp. 133-164. Pacific Anthropological Records No. 11, Bernice P. Bishop Museum, Honolulu.

- Gumerman, G.J. 1986. The role of competition and cooperation in the evolution of island societies. In *Island Societies: Archaeological Approaches to Evolution and Transformation*, edited by P.V. Kirch, pp. 42-49. Cambridge University Press, New York.
- Gumerman, G., D. Snyder and W. Masse. 1981. *An Archaeological Reconnaissance in the Palau Archipelago, Western Caroline Islands, Micronesia*. Center for Archaeological Investigations, Southern Illinois University, Carbondale.
- Håkansson, N.T. and M. Widgren. 2007. Labour and landscapes: the political economy of landesque capital in nineteenth century Tanganyika. *Geografiska Annaler: Series B, Human Geography* 89(3):233-248.
- Hammerstedt, S.W. 2005. Mississippian construction, labor, and social organization in western Kentucky. *Southeastern Archaeology* 24(1):11-27.
- Haas, J. (editor). 1990. *The Anthropology of War*. Cambridge University Press, New York.
- Haas, J. 2007. Warfare and the evolution of culture. In *Archaeology at the Millennium: A Sourcebook*, edited by G. Feinman and T. D. Price, pp. 329-350. Plenum Publishers, New York.
- Haslam, M. and J. Liston. 2008. The use of flaked stone artifacts in Palau, Western Micronesia. *Asian Perspectives* 47(2):405-428.
- Hayden, B. 1995. Pathways to power: principles for creating socioeconomic inequalities. In *Foundations of Social Inequality*, edited by D. Price and G. Feinman, pp. 15-86. Plenum Press, New York.
- Hayden, B. 1996. Feasting in prehistoric and traditional societies. In *Food and the Status Quest: A Interdisciplinary Perspective*, edited by W. Schiefenhovel and P. Weisner, pp. 128-147. Berhahn Books, Oxford.
- Hayden, B. and S. Villeneuve. 2011. A century of feasting studies. *Annual Review of Anthropology* 40:433-449.
- Hawkins, J. and O. Ishizuka. 2009. Petrologic evolution of Palau, a nascent island arc. *Island Arc* 18(4):599-641.
- Henry J.D., A.E. Haun and M.A. Kirkendall. 1996. *Archaeological mitigation program: Palau rural water system projects in Chol and Ngkeklau villages, Ngaraard State, Republic of Palau*. Draft report prepared for Monterey Mechanical. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai'i.
- Herdrich, D.J. and J.T. Clark. 1993. Samoan tia 'ave and social structure: methodological and theoretical considerations. In *The Evolution and Organization of Prehistoric Society in Polynesia*, edited by M.W. Graves and R.C. Green, pp. 52-63. New Zealand Archaeological Association, Monograph 19, Auckland.
- Hijikata, H. 1993. *Collective Works of Hijikata Hisakatsu: Society and Life in Palau, Volume I*. Translated and edited by H. Endo. The Sasakawa Peace Foundation, Tokyo. Originally published 1940, Kagaku Nanyo.
- Hijikata, H. 1995. *Collective Works of Hijikata Hisakatsu: Gods and Religion in Palau, Volume II*. Translated and edited by H. Endo. The Sasakawa Peace Foundation, Tokyo. Originally published 1940, Kagaku Nanyo.

Hijikata, H. 1996. *Collective Works of Hijikata Hisakatsu: Myths and Legends of Palau*. Translated and edited by H. Endo. The Sasakawa Peace Foundation, Tokyo. Originally published 1940, Kagaku Nanyo.

Hockin, J.P. 1803. *A supplement to the account of the Peleu Islands; Compiled from the journals of the Panther and Endeavor, two vessels sent by the Honourable East India Company to those islands in the year 1790 and from the oral communications of Captain H. Wilson*. Bulmer and Co., London.

Holyoak, L., M. Miko and F. Gibbons. 1998. *Inventory of Cultural Sites and Oral History in Ngeremlengui and Imeliik States Volume II: Oral History*. Division of Cultural Affairs, Historic Preservation Office, Ministry of Community and Cultural Affairs, Republic of Palau.

Hommon, R.J. 1976. *The Formation of Primitive States in Pre-Contact Hawaii*. Unpublished PhD Dissertation, Department of Anthropology, University of Arizona, Tucson.

Hommon, R.J. 1986. Social evolution in ancient Hawaii. In *Island Societies: Archaeological Approaches to Evolution and Transformation*, edited by P.V. Kirch, pp. 55–68. Cambridge University Press, Cambridge.

Hunt, T.L. and C.P. Lipo. 2001. Cultural elaboration and environmental uncertainty in Polynesia. In *Pacific 2000: Proceedings of the Fifth International Conference on Easter Island and the Pacific*, edited by C.M. Stevenson, G. Lee and F.J. Morin, pp. 103–116. Easter Island Foundation, Bearsville Press, Los Osos, California.

Hunter-Anderson, R.L. 1989. *Archaeological Investigations in the Small Boat Harbor Project Area, Agat, Guam*. Prepared for the U.S. Army Engineer District, Fort Shafter, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Hunter-Anderson, R.L. 1991. A review of traditional Micronesian high island horticulture in Belau, Yap, Chuuk, Pohnpei, and Kosrae. *Micronesica* 24(1):1–56.

Hunter-Anderson, R.L., G. Thompson and D. Moore. 1995. Rice as a prehistoric valuable in the Mariana Islands, Micronesia. *Asian Perspectives* 34(1):69–89.

Iida, A. 2012. *Research on landscape planning based on watershed analysis: A case study on Babeldaob, the Republic of Palau*. Unpublished PhD thesis, Department of Urban Engineering, University of Tokyo, Tokyo. (in Japanese).

Irwin, G. 1994. *The Prehistoric Exploration and Colonisation of the Pacific*. Cambridge University Press, New York.

Janusek, J.W. and A.L. Kolata. 2004. Top-down or bottom-up: rural settlement and raised field agriculture in the Lake Titicaca Basin of Bolivia. *Journal of Anthropological Archaeology* 23(4):404–430.

Johannes, R.E. 1981. *Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia*. University of California Press, Berkeley, California.

Johnson, A. and T. Earle. 1987. *The Evolution of Human Societies*. Stanford University Press, Stanford.

Joyce, R.A. 2004. Unintended consequences? Monumentality as a novel experience in Formative Mesoamerica. *Journal of Archaeological Method and Theory* 11:5–29.

Kahn, J.G. and P.V. Kirch. 2011. Monumentality and the materialization of ideology in Central Eastern Polynesia. *Archaeology in Oceania* 46(3):93–104.

- Kayanne, H., H. Yamano and R.H. Randall. 2002. Holocene sea-level changes and barrier reef formation on an oceanic island, Palau Islands, Western Pacific. *Sedimentary Geology* 150(1-2):47-60.
- Kaschko, M.W. 2007. Melekeok field report. In *Archaeological Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations Phase II. Volume VI: Fieldwork Reports*, edited by J. Liston, H.D. Tuggle, M.J. Tomanari-Tuggle and M. Desilets, pp. 134-150. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.
- Keate, G. 1788. *An Account of the Pelew Islands, situated in the Western Part of the Pacific Ocean, composed from the journals and communications of Captain Henry Wilson, and some of his officers, who, in August 1783, were there shipwrecked, in the Antelope, a packet belonging to the honourable East India Company*. G. Nicol, London.
- Keeley, L.H. 1996. *War Before Civilization: The Myth of the Peaceful Savage*. Oxford University Press, New York.
- Kirch, P.V. 1984. *The Evolution of the Polynesian Chiefdoms*. Cambridge University Press, Cambridge.
- Kirch, P.V. 1990a. Monumental architecture and power in Polynesian chiefdoms: A comparison of Tonga and Hawai'i. *World Archaeology* 22:206-222.
- Kirch, P.V. 1990b. The evolution of sociopolitical complexity in prehistoric Hawai'i. *Journal of World Prehistory* 4:311-345.
- Kirch, P.V. 1991. Chiefship and competitive involution: the Marquesas Islands of Eastern Polynesia. In *Chiefdoms: Power, Economy, and Ideology*, edited by T. Earle, pp. 119-145. Cambridge University Press, Cambridge.
- Kirch, P.V. 1994. *The Wet and the Dry: Irrigation and Agricultural Intensification in Polynesia*. University of Chicago Press, Chicago.
- Kirch, P.V. 1997. Introduction: The environmental history of Oceanic islands. In *Historical Ecology in the Pacific Islands: Prehistoric Environmental and Landscape Change*, edited by P.V. Kirch and T.L. Hunt, pp. 1-21. Yale University Press, New Haven.
- Kirch, P.V. 2000. *On the Road of The Winds: An Archaeological History of the Pacific Islands before European Contact*. University of California Press, Berkeley.
- Kirch, P.V. 2006. Agricultural intensification: a Polynesian perspective. In *Agricultural Strategies*, edited by J. Marcus and C. Stanish, pp. 191-220. Cotsen Institute of Archaeology, University of California, Los Angeles.
- Kirch, P.V. 2007. Three islands and an archipelago: reciprocal interactions between humans and island ecosystems in Polynesia. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh* 98:85-99.
- Kirch, P.V. (editor). 2010. *Roots of Conflict: Soils, Agriculture, and Sociopolitical Complexity in Ancient Hawai'i*. School of Advanced Research Press, Santa Fe.
- Kirch, P.V. and R.C. Green. 2001. *Hawaiki, Ancestral Polynesia: An Essay in Historical Anthropology*. Cambridge University Press, New York.

- Kirch, P.V. and T.L. Hunt (editors). 1997. *Historical Ecology in the Pacific Islands: Prehistoric Environmental and Landscape Change*. Yale University Press, New Haven, Connecticut.
- Kirch, P.V. and D. Yen. 1982. *Tikopia: The Prehistory and Ecology of A Polynesian Outlier*. Bulletin No. 238, Bernice P. Bishop Museum, Honolulu.
- Klee, G.A. 1972. *The Cyclic Realities of Man and Nature in a Palauan Village*. Unpublished PhD dissertation, Department of Anthropology, University of Oregon, Eugene.
- Knapp, A.B. 2009. Monumental architecture, identity and memory. In *Proceedings of the Symposium: Bronze Age Architectural Traditions in the East Mediterranean: Diffusion and Diversity* (Gasteig, Munich, 7-8 May, 2008), pp. 47-59. Verein zur Förderung der Aufarbeitung der Hellenischen Geschichte, Weilheim.
- Knapp, A.B. and W. Ashmore. 1999. Archaeological landscapes: constructed, conceptualized, ideational. In *Archaeologies of Landscape: Contemporary Perspectives*, edited by W. Ashmore and A.B. Knapp, pp. 1-30. Blackwell Publishing, Oxford.
- Kolb, M.J. 1991. *Social Power, Chiefly Authority, and Ceremonial Architecture, in an Island Polity, Maui, Hawai'i*. Unpublished PhD thesis, Department of Anthropology, University of California, Los Angeles.
- Kolb, M.J. 1992. Diachronic design changes in *heiau* temple architecture on the island of Maui, Hawai'i. *Asian Perspectives* 31(1):9-37.
- Kolb, M.J. 1994. Monumentality and the rise of religious authority in precontact Hawai'i. *Current Anthropology* 35(5):521-547.
- Kolb, M.J. 1997. Labor mobilization, ethnohistory, and the archaeology of community in Hawai'i. *Journal of Archaeological Method and Theory* 4(3/4):265-285.
- Kolb, M.J. 1999. Monumental grandeur and political florescence in pre-contact Hawai'i: excavations at Piilanihale Heiau, Maui. *Archaeology in Oceania* 34:71-82.
- Kolb, M.J. 2006. The origins of monumental architecture in ancient Hawai'i. *Current Anthropology* 47(4):657-665.
- Kolb, M.J. 2011. The genesis of monuments in island societies. In *The Comparative Archaeology of Complex Societies*, edited by M.E. Smith, pp. 138-164. Cambridge University Press, New York.
- Kolb, M.J. and B. Dixon. 2002. Landscape of war: rules and conventions of conflict in ancient Hawai'i (and elsewhere). *American Antiquity* 67:514-534.
- Krämer, A. 1917. *Ergebnisse der Südsee-Expedition 1908-1910*. II. Ethnographie; B. Mikronesien. Band 3, Teilband 1. Edited by G. Thilenius. Friederichsen, Hamburg (Human Relations Area File typescript, translated by Anonymous).
- Krämer, A. 1919. *Ergebnisse der Südsee-Expedition 1908-1910*. II. Ethnographie; B. Mikronesien. Band 3, Teilband 2. Edited by G. Thilenius. Friederichsen, Hamburg (Human Relations Area File typescript, translated by Anonymous).
- Krämer, A. 1926. *Ergebnisse der Südsee-Expedition 1908-1910*. II. Ethnographie; B. Mikronesien. Band 3, Teilband 3. Edited by G. Thilenius. Friederichsen, Hamburg (Human Relations Area File typescript, translated by Anonymous).

Krämer, A. 1929. *Ergebnisse der Südsee-Expedition 1908-1910*. II. Ethnographie; B. Mikronesien. Band 3, Teilband 4. Edited by G. Thilenius. Friederichsen, Hamburg (Human Relations Area File typescript, translated by Anonymous).

Kubary, J.S. 1873. *Die Palau Inseln in der Sudsee*. Journal des Museum Godeffroy I: 181-238, Teilband 1-3. Friederichsen, Hamburg. (Translated by Anonymous).

Kubary, J.S. 1885. *Die Socialen Einrichtungen Der Pelauer. Ethnographische Beitrage Zur Kenntniss Der Karolinischen Inselgruppe Und Nachbarschaft*. Heft I. Verlag Von A. Asher & Co., Berlin. (Translated by Anonymous).

Kubary, J.S. 1889. *Ethnographical Material for the Knowledge of the Caroline Archipelago Volume 1*, pp. 1-100. Verlag Von P.W.M. Trap, Leiden.

Kubary, J.S. 1892. *Ethnographical Material for the Knowledge of the Caroline Archipelago Volume 2 Industry of Palau*, pp. 117-219. Vol. 2. Leiden : Verlag Von P. W. M. Trap .

Kubary, J.S. 1895. *Ethnographical Material for the Knowledge of the Caroline Archipelago Volume 3*, pp. 222-298 . Verlag Von P.W.M. Trap, Leiden.

Kuhlken, R. 1994. *Agricultural Terracing in the Fiji Islands*. Unpublished PhD dissertation, Anthropology Department, Louisiana State University, Baton Rouge.

Kuhlken, R. 2002. Intensive agricultural landscapes of Oceania. *Journal of Cultural Geography* 19:161-195.

Lacquement, C. 2009. *Landscape Modification at Moundville: An Energetics Assessment of a Mississippian Polity*. Unpublished PhD dissertation, Department of Anthropology, University of Alabama, Tuscaloosa.

Ladefoged, T.N. 1992. *Evolutionary Processes in an Oceanic Chiefdom: Intergroup Aggression and Political Integration in Traditional Rotuman Society*. Unpublished PhD dissertation, Department of Anthropology, University of Hawai'i, Manoa.

Ladefoged, T.N. and M.W. Graves. 2000. Evolutionary theory and the historical development of dry-land agriculture in North Kohala, Hawai'i. *American Antiquity* 65:423-448.

Ladefoged, T.N. and M.W. Graves. 2006. The formation of Hawaiian territories. In *Archaeology of Oceania*, edited by I. Lilley, pp. 259-283. Blackwell Publishing, Oxford.

Ladefoged, T.N., M.W. Graves and M.D. McCoy. 2003. Archaeological evidence for agricultural development in Kohala, Island of Hawai'i. *Journal of Archaeological Science* 30:923-940

Ladefoged, T.N., P.V. Kirch, S.M. Gon III, O.A. Chadwick, A.S. Hartshorn and P.M. Vitousek. 2009. Opportunities and constraints for intensive agriculture in the Hawaiian archipelago prior to European contact. *Journal of Archaeological Science* 36:2374-2383.

Lal, R. 2001. Soil degradation by erosion. *Land Degradation and Development* 12(6):519-539.

Lansing, S. 1991 *Priests and Programmers: Technologies of Power in the Engineered Landscape of Bali*. Princeton University Press, Princeton, New Jersey.

Latinis, D. 2000. The development of subsistence system models for Island Southeast Asia and Near Oceania: the nature and role of arboriculture and arboreal-based economies. *World Archaeology* 32(1):41-67.

Leach, H.M. 1999. Intensification in the Pacific: a critique of the archaeological criteria and their application. *Current Anthropology* 40:311–339.

Lindstrom, L., 1984. Doctor, lawyer, wise man, priest: big-men and knowledge in Melanesia. *Man* (19)291–309.

Liston, J. 2005. An assessment of radiocarbon dates from Palau, Western Micronesia. *Radiocarbon* 47:295–354.

Liston, J. 2007a. *Archaeological Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase II. Volume V: Lab Analyses, Syntheses, Recommendations*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Liston, J. 2007b. *Archaeological Data Recovery of Omsangel Hill, Airai State, Republic of Palau*. Prepared for TDK Architects, Koror, Republic of Palau. Garcia and Associates, Kailua, Hawai'i.

Liston, J. 2008. *Archaeological Data Recovery at Tabelmeduu, Ngaraard Earthwork District, Republic of Palau*. Prepared for Ngaraard State, Republic of Palau. Garcia and Associates, Kailua, Hawai'i.

Liston, J. 2009. Cultural chronology of earthworks in Palau, Western Micronesia. *Archaeology in Oceania* 44:56–73.

Liston, J. 2010. *Archaeological Data Recovery at Ngerumelong Burial Platform, Ngermid (OR-1:1), Koror State, Republic of Palau*. Prepared for Sandra S. Pierantozzi.

Liston, J. 2011a. *Archaeological Monitoring and Emergency Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume XII: Lab Analyses, Discussion, Syntheses*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Liston, J. 2011b. *Archaeological Monitoring for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume XI: Monitoring: Fieldwork Reports*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Liston, J. and M. Miko. 2011. Oral tradition and archaeology: Palau's earth architecture. In *Pacific Island Heritage: Archaeology, Identity, Community*, edited by J. Liston, G. Clark and D. Alexander. Terra Australis, ANU EPress, Canberra.

Liston, J. and T.M. Rieth. 2011. *Archaeological Monitoring for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume X: Monitoring: Fieldwork Reports*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Liston, J., M.W. Kaschko and D.J. Welch. 1998. *Archaeological Inventory Survey of the Capitol Relocation Project, Melekeok, Republic of Palau*. Prepared for Architects Hawai'i, Inc., Honolulu. International Archaeological Research Institute, Inc., Honolulu.

Liston, J., T.M. Mangieri, D. Grant, M.W. Kaschko and H.D. Tuggle. 2007. *Archaeological Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase II. Volume VI: Fieldwork Reports*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

- Liston, J., T.M. Rieth and H.D. Tuggle. 2011. Traditional pottery analysis. In *Archaeological Monitoring and Emergency Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume XII: Lab Analyses, Discussion, Syntheses*, edited by J. Liston, pp. 262-332. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.
- Liston, J., J. Tellei and U. Basilius. 1998. *Archaeological Inventory Survey, PNCC Telecommunication System-Babeldaob, Peleliu, Angaur, and Kayangel Islands, Republic of Palau*. Prepared for the Palau National Communication Corporation. International Archaeological Research Institute, Inc., Honolulu.
- Liston, J., J. Tellei, U. Basilius and F.K. Rehuher. 2002. *Archaeological Survey, Monitoring, Oral History of Bore Holes, Rock Quarries, and Coral Dredging Locations for the Compact Road, Babeldaob Island, Republic of Palau*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.
- Liston, J. and H.D. Tuggle. 1998. The terraces of Palau: new information on function and age. Paper presented at the Society for American Archaeology 63rd Annual Meeting, Seattle, Washington.
- Liston, J. and H.D. Tuggle. 2001. Prehistoric warfare in Palau. Paper presented at the Society for American Archaeology 66th Annual Meeting, New Orleans, Louisiana.
- Liston, J. and H.D. Tuggle. 2006. Prehistoric warfare in Palau. In *The Archaeology of Warfare: Prehistories of Raiding and Conquest*, edited by E. Arkush and M.W. Allen, pp 148-183. University Press of Florida, Gainesville.
- Lucking, L.J. 1981. *An Archaeological Investigation of the Prehistoric Palauan Terraces*. Prepared for the Historic Preservation Office, Trust Territory of the Pacific Islands, Saipan.
- Lucking, L.J. 1984. *An Archaeological Investigation of Prehistoric Palauan Terraces*. Unpublished PhD dissertation, Department of Anthropology, University of Minnesota, Minneapolis.
- Madsen, M., C. Lipo and M. Cannon. 1999. Fitness and reproductive trade-offs in uncertain environments: explaining the evolution of cultural elaboration. *Journal of Anthropological Archaeology* 18:251-281
- Mann, M. 1986. *The Sources of Social Power*. Cambridge University Press, Cambridge.
- Manner, H. 2008. Directions for long-term research in traditional agricultural systems of Micronesia and the Pacific Islands. *Micronesica* 40(1/2):63-86.
- Manner, H.I., D. Mueller-Dombois and M. Rapaport. 1999. Terrestrial ecosystems. In *The Pacific Islands, Environment and Society*, edited by M. Rapaport, pp. 93-108. Bess Press, Honolulu.
- Maragos, J.E., C. Birkeland, C. Cook, N. Idechong, D. Otobed, M. Guilbeaux, B. Smith and R. Smith. 1994. *Marine and Coastal Areas Survey of the Main Palau Islands - Rapid Ecological Assessment Synthesis Report, Part 2*. Prepared for the Bureau of Resources and Development, Republic of Palau.
- Martinsson-Wallin, H. 1994. *Ahu-The Ceremonial Stone Structures of Easter Island*. Societas Archaeologica Upsaliensis, Volume 19, Uppsala.

- Martinsson-Wallin, H. 2000. "No Stone Unturned"... a reflection on the recycling of worked stones on Rapa Nui. In *Essays in Honour of Arne Skjølsvold 75 Years*, edited by P. Wallin, and H. Martinsson-Wallin, pp. 44-60. The Kon-Tiki Museum Occasional Papers Volume 5, Oslo.
- Masse, W.B. 1989. *The Archaeology and Ecology of Fishing in the Belau Islands, Micronesia*. Unpublished PhD dissertation, Department of Anthropology, Southern Illinois University, Carbondale.
- Masse, W.B., J. Liston, J. Carucci and J.S. Athens. 2006. Evaluating the effects of climate change on environment, resource depletion, and culture in the Palau Islands between AD 1200 and 1600. *Quaternary International* 151:106-132.
- Masse, W.B., D. Snyder, and G.J. Gumerman. 1984. Prehistoric and historic settlement in the Palau Islands, Micronesia. *New Zealand Journal of Archaeology* 6:107-127.
- McCoy, P.C., M.I. Weisler, J. Zhao and Y.X. Feng. 2009. ²³⁰Th dates for dedicatory corals from a remote alpine desert adze quarry on Mauna Kea, Hawai'i. *Antiquity* 83(320):445-457.
- McCoy, M.D. and M.W. Graves. 2010. The role of agricultural innovation on Pacific Islands: a case study from Hawai'i Island. *World Archaeology* 42(1):90-107.
- McCoy, M.D., T.N. Lidefeged, M.W. Graves and J.W. Stephen. 2011. Strategies for constructing religious authority in ancient Hawai'i. *Antiquity* 85(329):927-941.
- McCutcheon, M.S. 1981. *Resource Exploitation and the Tenure of Land and Sea in Palau*. Unpublished PhD dissertation, Department of Anthropology, University of Arizona, Tucson.
- McCutcheon, M.S. 1985. Reading the taro cards: explaining agricultural change in Palau. In *Food Energy in Tropical Ecosystems*, edited by D.J. Cattle and K.H. Schwern, pp. 167-188. Gordon and Breach Science Publishers, Volume 4, New York.
- McGlade, J. 1995. Archaeology and the ecodynamics of human-modified landscapes. *Antiquity* 68(262):113-132.
- McKnight, R.K. 1960. *Competition in Palau*. Unpublished PhD dissertation, Anthropology Department, Ohio State University, Columbus.
- McKnight, R.K. and A. Obak. 1959. *Yam Cultivation in Palau*. Trust Territory of the Pacific Islands, Saipan.
- McKnight, R.K. and A. Obak. 1960. *Taro Cultivation in Palau*. Trust Territory of the Pacific Islands, Saipan.
- Meyer, W.J. and C.L. Crumley. 2011. Historical ecology: using what works to cross the divide. In *Atlantic Europe in the First Millennium BC: Crossing the Divide*, edited by T. Moore and X.L. Armanda, pp. 109-134. Oxford University Press, Oxford.
- Miles, J.E., M.F. Ueki and R.V. Bishop. 1994. *Background and Situation Assessment of Land Resources (Agricultural) Development in Palau*. Palau Master Development Plan. Koror, Republic of Palau.
- Mills, B.J. (editor). 2000. *Alternative Leadership Strategies in the Prehispanic Southwest*. University of Arizona Press, Tucson.
- Mitovica J.X. and W.R. Peltier. 1991. On postglacial geoid subsidence over the equatorial oceans. *Journal of Geophysical Research* 96(B12):20053-20071.

- Moore, J. 1996. *Architecture and Power in the Ancient Andes: The Archaeology of Public Buildings*. Cambridge University Press, Cambridge.
- Morgan, W.N. 1988. *Prehistoric Architecture in Micronesia*. University of Texas Press, Austin.
- Morrison, R.J. 1988. Occurrence and distribution of acid soils in Oceania. *Proceedings of the Third International Soil Management Workshop on the Management and Utilization of Acid Soils in Oceania*. Republic of Palau.
- Morrison, K.D. 1994. The intensification of production: archaeological approaches. *Journal of Archaeological Method and Theory* 1(2):111–160.
- Morrison, K.D. 2006. Intensification at situated process: landscape history and collapse. In *Agricultural Strategies*, edited by J. Marcus and C. Stanish, pp. 71–91. Costen Institute of Archaeology, University of California, Los Angeles.
- Muller, J. 1997. *Mississippian Political Economy*. Plenum Press, New York.
- Mueller-Dombois, D. and F.R. Fosberg. 1998. *Vegetation of the Tropical Pacific Islands*. Springer-Verlag, New York.
- Nero, K.L. 1987. *A Cherechar a Lokelii: Beads of History of Koror, Palau, 1783–1983*. Unpublished PhD thesis, Department of Anthropology, University of California, Berkeley.
- Netting, R. 1993. *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*. Stanford University Press, Palo Alto, California.
- Ngiralmu, M. and R. Bishop. 1999. A report on the rapid rural appraisal of *Colocasia taro* agriculture in Palau. In *A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii, and American Samoa*, edited by A. Vargo, pp. 97–105. U.S. Department of Agriculture, Honolulu, Hawai'i.
- NOAA (National Oceanic and Atmospheric Administration). 2012. Pacific ENSO Update. 1st Quarter, 2012, Vol. 18(1). Republic of Palau. http://www.prh.noaa.gov/peac/peu/2012_1st/palau.php. Accessed July 2012.
- Nunn, P.D. 2000a. Environmental catastrophe in the Pacific Islands around A.D. 1300. *Geoarchaeology* 15(7):715–740.
- Nunn, P.D. 2000b. Illuminating sea-level fall around AD 1220–1510 (730–440 cal yr BP) in the Pacific Islands: implications for environmental change and cultural transformation. *New Zealand Geographer* 56:46–54.
- Nunn, P.D. 2003. Revising ideas about environmental determinism: human–environment relations in the Pacific Islands. *Asia Pacific Viewpoint* 44(1):63–72.
- Nunn, P.D. 2007a. The AD 1300 Event in the Pacific basin. *The Geographical Review* 97(1):1–23.
- Nunn, P.D. 2011. Disruption of coastal societies in the Pacific Islands from rapid sea-level fall about AD 1300: new evidence from northern Viti Levu Island, Fiji. *Journal of Coastal Conservation*, 1–11.

Nunn P.D., R.L. Hunter-Anderson, M. Carson, F. Thomas, S. Ulm and M. Rowland. 2007. Times of plenty, times of less: last millennium societal disruption in the Pacific Basin. *Human Ecology* 35:385-401.

NRCS (Natural Resources Conservation Services). 2010. *Soil Survey of the Islands of Palau, Republic of Palau*. U.S. Department of Agriculture, Natural Resources Conservation Service, Pacific Basin Area. Mongmong, Guam. Accessible online at: http://soils.usda.gov/survey/printed_surveys/.

Olsudong, R., C.T. Emesiochel and E.T. Kloulechad. 1998. *Inventory of Cultural Sites and Oral History in Ngeremlengui and Imeliik States Volume I: Inventory of Cultural and Sites Draft*, Division of Cultural Affairs, Historic Preservation Office, Ministry of Community and Cultural Affairs, Republic of Palau.

Olsudong, R., C.T. Emesiochel and E.T. Kloulechad. 1999. *Inventory of Cultural and Historical Sites and Collection of Oral History in Kayangel and Ngarchelong States, Volume I: Inventory of Cultural and Historical Sites (Draft)*. Division of Cultural Affairs Historic Preservation Office Ministry of Community and Cultural Affairs Republic of Palau.

Olsudong, R., C.T. Emesiochel and E.T. Kloulechad. 2008. *Inventory of Historic Properties in Ngiwal State, Republic of Palau (Final)*. Bureau of Arts and Culture, Historic Preservation Office, Ministry of Community and Cultural Affairs.

Ono, R. and G. Clark. 2011. A 2500-year record of marine resource use on Ulong Island, Republic of Palau. *International Journal of Osteoarchaeology*. DOI: 10.1002/oa.1226

Oppo, D., Y. Rosenthal and B. Linsley. 2009. 2,000-year-long temperature and hydrology reconstructions from the Indo-Pacific warm pool. *Nature* 460(72590):1113-1116.

O'Reilly, C.E. 2010. *Shells, Stones, and Science. Climate Change and Site Abandonment in the Rock Islands of Palau, Western Micronesia*. Unpublished honours thesis, School of Archaeology and Anthropology, Australian National University, Canberra.

Osborne, D. 1966. *The Archaeology of the Palau Islands, An Intensive Survey*. Bishop Museum Bulletin 230, Bishop Museum Press, Honolulu.

Osborne, D. 1979. Archaeological test excavations, Palau Islands, 1968-1969. *Micronesia Supplement 1*.

Palau Society of Historians. 1995. *Deaths and Funerals*. Palau Division of Arts and Culture, Koror, Republic of Palau.

Pantaleo, J. 2002. *Archaeological Investigations of the Proposed Rock Quarry Ngedesaker, Ngeremlengui State, Republic of Palau*. Prepared for Jess T. Lizama & Associates, Inc. Palau Cultural and Environmental Resource Management, Republic of Palau.

Parmentier, R.J. 1981. *The Sacred Remains: An Historical Ethnography of Ngeremlengui, Palau*. Unpublished PhD Dissertation, Department of Anthropology, University of Chicago, Chicago.

Parmentier, R.J. 1987. *The Sacred Remains: Myth, History, and Polity in Belau*. The University of Chicago Press, Chicago.

Parmentier, R.J. 1988. Transactional symbolism in Belauan mortuary rites: a diachronic study. *Journal of the Polynesian Society* 97(3):281-312.

- Parmentier, R.J. and H. Kopnina-Geyer. 1996. Miklohuo-Maclay in Palau, 1876. *Isla: A Journal of Micronesian Studies* 4(1):71-108.
- Pauketat, T.R. 2000. The tragedy of the commoners. In *Agency in Archaeology*, edited by M. Dobres and J. Robb, pp. 113-129. Routledge, London.
- Pauketat, T.R. 2007. *Chiefdoms and Other Archaeological Delusions*. AltaMira Press, Plymouth, United Kingdom.
- Pauketat, T.R. and S.M. Alt. 2005. Agency in a postmold? Physicality and the archaeology of culture-making. *Journal of Archaeological Method and Theory* 12(3):213-236.
- Peebles, C.S. and S.M. Kus. 1977. Some archaeological correlates of ranked societies. *American Antiquity* 42:421-448.
- Peterson, C.E. and R.D. Drennan. 2011. Patterned variation in regional trajectories of community growth. In *The Comparative Archaeology of Complex Societies*, edited by M.E. Smith, pp. 88-137. Cambridge University Press, New York.
- Phear, S. 2003. Painted pottery in Palau: new evidence challenges past interpretations. *Antiquity* 77(296).
- Phear, S. 2007. *The Monumental Earthworks of Palau, Micronesia: A Landscape Perspective*. BAR International Series 1626. British Archaeological Reports, Oxford.
- Phear, S. 2008. Subsistence and island landscape transformations: investigating monumental earthworks in Ngaraard State, Republic of Palau, Micronesia. In *Terra Australis 29 - Islands of Inquiry: Colonization, Seafaring and the Archaeology of Maritime Landscapes*, edited by G. Clark, F. Leach F. and S. O'Connor. ANU EPress, Australian National University, Canberra.
- Phear, S., G. Clark and A. Anderson. 2003. A radiocarbon chronology of Palau. In *Pacific Archaeology: Assessments and Prospects*, edited by C. Sand, pp. 255-263. Les Cahiers de l'Archéologie en Nouvelle-Calédonie 15. Musée de Nouvelle-Calédonie, Nouméa.
- Pregill, G.K. and D.W. Steadman. 2000. Fossil vertebrates from Palau, Micronesia: a resource assessment. *Micronesica* 33(1/2):137-152.
- Prufer, K. M., H. Moyes, B. J. Culleton, A. Kindon, D. J. Kennett, B. Culleton and D. Kennett. 2011. Formation of a complex polity on the eastern periphery of the Maya Lowlands. *Latin American Antiquity* 22(2):199-223.
- Ragone, D. 1997. Soil Nutrient Management in Palau. Paper presented at the workshop on Utilization of Soil and Plant Analysis for Sustainable Nutrient Management in the American Pacific, Mangilao, Guam.
- Redman, C. 1999. *Human Impact on Ancient Environments*. University of Arizona Press, Tucson.
- Reimer, P.J., M.G.L. Baillie, E. Bard, A. Bayliss, J.W. Beck, C.J.H. Bertrand, P.G. Blackwell, C.E. Buck, G.S. Burr, K.B. Cutler, P.E. Damon, R.L. Edwards, R.G. Fairbanks, M. Friedrich, T.P. Guilderson, A.G. Hogg, K.A. Hughen, B. Kromer, G. McCormac, S. Manning, C. Bronk Ramsey, R.W. Reimer, S. Remmele, J.R. Southon, M. Stuiver, S. Talamo, F.W. Taylor, J. van der Plicht and C.E. Weyhenmeyer. 2004. IntCal04 terrestrial radiocarbon age calibration, 0-26 kyr BP. *Radiocarbon* 46:1029-1958.
- Renfrew, C. 1974. Beyond a subsistence economy: the evolution of social organization in prehistoric Europe. In *Reconstructing Complex Societies: An Archaeological Colloquium*,

edited by C.B. Moore, pp. 69-95. Supplement to the Bulletin of the American Schools of Oriental Research, No. 20, Cambridge.

Renfrew, C. 1983. The social archaeology of megalithic monuments. *Scientific American* 249:152-163.

Renfrew, C. 1986 Introduction: peer polity interaction and sociopolitical change. In *Peer Polity Interaction and Sociopolitical Change*, edited by C. Renfrew and J. Cherry, pp. 1-18. Cambridge University Press, Cambridge.

RoP (Republic of Palau). 2009. *Pacific Adaptation to Climate Change-Palau Project Proposal*. Developed in collaboration with the Office of Environmental Response and Coordination, Republic of Palau.

Rice, P.M. 2009. On classic Maya political economies. *Journal of Anthropological Archaeology* 28(1):70-84.

Rieth, T.M. 2011. Vertebrate Faunal Remains. In *Archaeological Monitoring and Emergency Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume XII: Lab Analyses, Discussion, Syntheses*, edited by J. Liston, pp. 250-257. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Rieth, T.M. and J. Liston. 2001. *Archaeological Data Recovery at Ngermereues Ridge, Ngesaol, Koror, Republic of Palau*. Prepared for Winzler & Kelly, Consulting Engineers. International Archaeological Research Institute, Inc., Honolulu.

Ikehara-Quebral, R. 2007. *An Osteological Analysis of Human Remains from Ngercheluuk and Ngermechau Villages, Ngiwal State, Babeldaob Island, Republic of Palau. Appendix C*. Prepared for the Palau National Communications Corporation. International Archaeological Research Institute, Inc., Honolulu.

Ritzenthaler, R.E. 1954. *Native Money of Palau*. Publications in Anthropology. Milwaukee Public Museum, Milwaukee.

Sachs J.P., D. Sachse, R. Smittenberg, Z. Zhang, D. Battisti, and S. Golobic. 2009. Southward movement of the Pacific intertropical convergence zone AD1400-1850. *Nature Geoscience* 2:519-525

Sack, R. 1986. *Human Territoriality, Its Theory and History*. Cambridge University Press, Cambridge.

Sahlins, M. 1958. *Social Stratification in Polynesia*. University of Washington Press, Seattle.

Sand, C. 1999. From the swamp to the terrace: intensification of the horticultural practices in New Caledonia from first settlement to European contact. In *The Prehistory of Food: Appetites for Change*, edited by C. Gosden and J. Hather, pp. 252-269. One World Archaeology Series, Volume 32, Routledge, London.

Sand, C. 2002. Creations and transformations of prehistoric landscapes in New Caledonia, the southernmost Melanesian Islands. In *Pacific Landscapes: Archaeological Approaches*, edited by T. Lidefeged and M. Graves, pp. 11-34. Easter Island Foundation. Bearsville Press, Los Osos, California.

Saxe, A.A. 1971. Social dimensions of mortuary practices in a Mesolithic population from Wadi Halfa, Sudan. *Memoirs of the Society for American Archaeology* 25:39-57.

Scarborough, V.L. 2003. *The Flow of Power: Ancient Water Systems and Landscapes*. School for Advanced Research Press, Santa Fe.

Schilt, A.R. 1984. *Subsistence and Conflict in Kona, Hawai'i: an Archaeological Study of the Kuakini Highway Realignment Corridor*. Report 84-1, Department of Anthropology, Bernice P. Bishop Museum, Honolulu.

Semper, K. 1982 [1873]. *The Palau Islands in the Pacific Ocean (Die Palau-Inseln im Stillen Ocean)*. Translated by Robert D. Craig. Micronesian Area Research Center, University of Guam, Mangilao.

Suguira, K. 1958. Land tenure in the Palau Islands. In *Land Tenure Patterns: Trust Territory of the Pacific Islands*, edited by J.D. Young, pp. 289-336. Office of the Staff Anthropologist, Trust Territory of the Pacific Islands, Guam.

Seikel, K. 2011. Mortuary contexts and social structure at Nan Madol, Pohnpei. *The Journal of Island and Coastal Archaeology* 6(3):442-460.

Shady-Solis, R., J. Haas and W. Creamer. 2001. Dating Caral, a preceramic site in the Supe Valley on the central coast of Peru. *Science* 292(5517):723-726.

Shepardson, B.L. 2005. The role of Rapa Nui (Easter Island) statuary as territorial boundary markers. *Antiquity* 79:169-178.

Shepardson, B.L. 2006. *Explaining Spatial and Temporal Patterns of Energy Investment in the Prehistoric Statuary of Rapa Nui (Easter Island)*. Unpublished PhD dissertation. Department of Anthropology, University of Hawai'i, Manoa.

Simpson, D. 2009. Rapa Nui's political economy and the visibility of its monumental architecture. *Rapa Nui Journal* 23(2):131-148.

Smailes, R.L. 2011. Building Chan Chan: a project management perspective. *Latin American Antiquity* 22(1):37-63.

Small, D.B. 2009. The dual-processual model in ancient Greece: applying a post-neoevolutionary model to a data-rich environment. *Journal of Anthropological Archaeology* 28(2):205-221.

Smith, A.T. 2003. *The Political Landscape: Constellations of Authority in Early Complex Polities*. University of California Press, Berkeley.

Smith, A. 2004. Are the earliest field monuments of the Pacific landscape serial sites? In *A Pacific Odyssey: Archaeology and Anthropology in the Western Pacific, Papers in Honor of Jim Specht*, editors V. Attenbrow and R. Fullagar, pp. 133-138. Records of the Australia Museum, Supplement 29, Sydney.

Smith, C.W. 1983. *Soil Survey of Islands of Palau, Republic of Palau*. Soil Conservation Service, U.S. Department of Agriculture, Honolulu.

Smith, C.W. and N.R. Babik. 1988. Properties and management considerations of some acid soils on the islands of Palau. In *Proceedings of the Third International Soil Management Workshop on the Management and Utilization of Acid Soils of Oceania. February 2-6, 1987. Koror, Palau*, editors J.L. Demeterio and B. DeGuzman, pp. 39-61. University of Guam, Guam.

Smith, M. 1987. Household possessions and wealth in agrarian states: implications for archaeology. *Journal of Anthropological Archaeology* 6:297-335.

Smittenberg, R.H., C. Saenger, M.N. Dawson and J.P. Sachs. 2011. Compound-specific D/H ratios of the marine lakes of Palau as proxies for West Pacific warm pool hydrologic variability. *Quaternary Science Reviews*. 30(7):921-933.

Snyder, D. 1989. *Towards Chronometric Models for Palauan Prehistory: Ceramic Attributes*. Unpublished PhD dissertation, Department of Anthropology. Southern Illinois University, Carbondale.

Snyder, D. 1997. Two millennium of change: A model of settlement system dynamics in Palau, Micronesia. Paper presented at the Society for American Archaeology 62nd Annual Meeting, Nashville.

Snyder, D. and B.M. Butler. 1989. *Archaeological Survey in Ngatpang and Ngaremlengui States, Republic of Palau*. The Micronesian Endowment, U.S. National Park Service and the Division of Cultural Affairs, Republic of Palau. Center for Archaeological Investigations, Southern Illinois University, Carbondale.

Snyder, D. and B. Butler. 1990. *Archaeology and Historic Preservation in Palau* Final report prepared for the Micronesian Resources Study, U.S. National Park Service. Division of Cultural Affairs, Republic of Palau.

Snyder, D., W.B. Masse and J. Carucci. 2011. Dynamic settlement, landscape modification, resource utilisation and the value of oral traditions in Palauan archaeology. In *Pacific Island Heritage: Archaeology, Community, and Identity*, edited by J. Liston, G. Clark and D. Alexander. ANU EPress, Australian National University, Canberra.

Spencer, J.E. and G.A. Hale. 1961. The origin, nature, and distribution of agricultural terracing. *Pacific Viewpoint* 2(1):1-40.

Spriggs, M. 1981. *Vegetable Kingdoms: Taro Irrigation and Pacific Prehistory*. Unpublished PhD dissertation, Department of Anthropology. Australian National University, Canberra.

Spriggs, M. 1984. Taro irrigation techniques in the Pacific: Labour inputs, yields, and cropping cycles. In *The Edible Aroids*, edited by S. Chandra, pp. 123-135. Clarendon Press, Oxford.

Spriggs, M. 1997. Landscape catastrophe and landscape enhancement: are either or both true in the Pacific? In *Historical Ecology in the Pacific Islands*, edited by P.V. Kirch and T.L. Hunt, pp. 80-104. Yale University Press, New Haven.

Spriggs, M. 2007. Population in a vegetable kingdom: Aneityum Island (Vanuatu) at European Contact in 1830. In *The Growth and Collapse of Pacific Island Societies: Archaeological and Demographic Perspectives*, edited by P.V. and J. Rallu, pp. 278-305. University of Hawai'i Press, Honolulu.

Spriggs M. and A. Anderson. 1993. Late colonization of East Polynesia. *Antiquity* 67(255):200-217.

Steadman, D.W. 2006. *Extinction and Biogeography of Tropical Pacific Birds*. University of Chicago Press, Chicago.

Stevenson, C.M. 1986. The sociopolitical structure of the southern coastal area of Easter Island: AD 1300-1864. In *Island Societies: Archaeological Approaches to Evolution and Transformation*, edited by P.V. Kirch, pp. 69-77. Cambridge University Press, Cambridge.

Stevenson, C.M. 2002. Territorial divisions on Easter Island in the sixteenth century: evidence from the distribution of ceremonial architecture. In *Pacific Landscapes: Archaeological*

Approaches, edited by T.N. Ladefoged and M.W. Graves, pp. 213-230. Easter Island Foundation, Los Osos, California.

Suggs, R. C. 1961. The derivation of Marquesan culture. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 91(1):1-10.

Tainter, J.A. 1978. Mortuary practices and the study of prehistoric social systems. *Advances in Archaeological Method and Theory* 1:105-141.

Tellei, J. 1998b. Oral history documentation. In *Archaeological Inventory Survey of the Capitol Relocation Project, Melekeok, Republic of Palau*, edited by J. Liston, M.W. Kaschko, and D.J. Welch. Prepared for Architects Hawai'i, Inc., Honolulu. International Archaeological Research Institute, Inc., Honolulu.

Tellei, J., U. Basilius and F.K. Rehuher. 1998a. Oral history documentation. In *Archaeological inventory survey, Palau Peninsula Resort, Ngerekebesang Island, Koror, Republic of Palau*. C.M. Magnuson and J. Liston, pp. 91-109. Prepared for Haas and Haynie, San Francisco, California. International Archaeological Research Institute, Inc., Honolulu.

Tellei, J., U. Basilius and F.K. Rehuher. 1998b. *Oral History Documentation of Specific Features within Archaeological Sites to be Affected by the PNCC Underground Telecommunications System*. Prepared for the Palau National Communication Corporation. International Archaeological Research Institute, Inc., Honolulu.

Tellei, J., U. Basilius and F.K. Rehuher. 2005. *Palau Compact Road Archaeological Investigations, Babeldaob Island, Republic of Palau, Phase I: Intensive Archaeological Survey. Volume III: Oral History Documentation*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Tilley, C. 1994. *A Phenomenology of Landscape: Places, Paths and Monuments*. Berg, Oxford.

Treacy, J. and W. Denevan. 1994. The creation of cultivable land through terracing. In *The Archaeology of Garden and Field*, edited by N. Miller and K. Gleason, pp. 91-110. University of Pennsylvania Press, Philadelphia.

Trigger, R.G. 1990. Monumental architecture: a thermodynamic explanation of symbolic behaviour. *World Archaeology* 22:119-132.

Trubitt, M.R.D. 2000. Mound building strategies and prestige goods exchange: changing strategies in the Cahokia chiefdom. *American Antiquity* 65:669-690.

Tuggle, H.D. 2007. Ngarchelong and Ngaraard field reports. In *Archaeological Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations Phase II: Volume V: Fieldwork Reports*, edited by J. Liston, H.D. Tuggle, T.M. Mangieri, M.W. Kaschko and M. Desilets, pp. 81-129, 150-197, 314-424. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Tuggle, H.D. 2011. Ngaraard ridgeline field report. In *Archaeological Monitoring and Emergency Data Recovery for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume IX: Planned Data Recovery Field Reports*. edited by H.D. Tuggle, T.M. Mangieri and J. Liston. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Tuggle, H.D, T.M. Mangieri, and J. Liston. 2011. *Archaeological Monitoring for the Compact Road, Babeldaob Island, Republic of Palau. Historic Preservation Investigations, Phase III. Volume IX: Planned Data Recovery: Fieldwork Reports*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division. International Archaeological Research Institute, Inc., Honolulu.

Van der Brug, O. 1984. *Water Resources of the Palau Islands*. Water-Resources Investigations Report 83-4140. United States Geological Survey, Honolulu.

Van der Brug, O. 1986. *The 1983 Drought in the Western Pacific*. Open File Report. United States Geological Survey, Honolulu.

Van Tilburg, J. 1986. *Power and Symbol: The Stylistic Analysis of Easter Island Monolithic Sculpture*. Unpublished PhD dissertation, Department of Anthropology, University of California, Los Angeles.

Van Tilburg, J. 1991. Anthropomorphic stone monoliths on the islands of Koror and Babeldaob, Republic of Palau (Palau), Micronesia. *Bishop Museum Occasional Papers No. 31*. Bernice P. Bishop Museum, Honolulu.

Van Tilburg, J. 1994. *Easter Island: Archaeology, Ecology, and Culture*. Smithsonian Institution Press, Washington, D.C.

Vega-Centeno, R. 2010 . Cerro Lampay: architectural design and human interaction in the north central coast of Peru. *Latin American Antiquity* 21(2):115-145.

Vidich, A. 1949. *Political Factionalism in Palau: Its Rise and Development*. CIMA Report No. 23. National Research Council, Pacific Science Board, Washington, D.C.

Wallin, P. 1993. *Ceremonial Stone Structures. The Archaeology and Ethnohistory of the Marae Complex in the Society Islands, French Polynesia*. Aun. 18. Societas Archaeologica Upsaliensis, Uppsala.

Wallin, P. and H. Martinsson-Wallin. 2011. Monumental structures and the spirit of chiefly actions. *Time and Mind* 4(1):43-58.

Webster, D. and J. Kirker. 1995. Too many Maya, too few buildings: investigating construction potential at Copan, Honduras. *Journal of Anthropological Research* 51(4):363-387.

Weisler, M.I. (editor). 1997. *Prehistoric Long-Distance Interaction in Oceania: An Interdisciplinary Approach*. New Zealand Archaeological Association. Volume 21, Auckland.

Wells, E.C. 2006. Recent trends in theorizing prehispanic Mesoamerican economies. *Journal of Archaeological Research* 14:265-312.

Wells, E.C. and P.A. McAnany (editors). 2008. *Dimensions of Ritual Economy*. Research in Economic Anthropology, Volume 27. JAI Press, Emerald Group Publishing Limited, Bingley, England.

Wickler, S.K. 2002. Terraces and villages: transformation of the cultural landscape in Palau. In *Pacific Landscapes: Archaeological Approaches in Oceania*, edited by T.N. Ladefoged and M. Graves, pp. 63-96. Easter Island Foundation, Bearsview Press, Los Osos, California.

Wickler, S.K., D.J. Welch, M.J. Tomonari-Tuggle, J. Liston, and H.D. Tuggle. 2005. *Intensive Archaeological Survey For the Palau Compact Road, Babeldaob Island, Palau. Historic Preservation Investigations Phase I, Volume I: Scope, Background, Results, Evaluation, and*

Recommendations. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Winterhalder, B. and E.A. Smith. 2000 . Analyzing adaptive strategies: human behavioral ecology at twenty-five. *Evolutionary Anthropology* 9(2):51-72.

Wittfogel, K.A. 1955. Developmental aspects of hydraulic societies. In *Irrigation Civilizations: A Comparative Study*. Department of Cultural Affairs, Pan American Union Social Sciences Monographs I:43-53. Washington, D.C.

Wolanski, E. and K. Furukawa. 2007. The oceanography of Palau. In *Coral Reefs of Palau*, edited by H. Kayanne, M. Omori, K. Fabricius, E. Verheij, P. Colin, Y. Golbuu and H. Yukihiro, pp. 59-72. Palau International Coral Reef Center, Koror, Republic of Palau.

Wright, D. 2005. *The Archaeology of Aulong Island and the Colonisation of Palau*. Unpublished MA thesis, Department of Archaeology and Natural History, Australian National University, Canberra.

Yamata, I. 1930. Ancient village sites of Palau Island. *Geographical Review* 6(10). Bernice P. Bishop Museum.

Yawata, I. 1963. Rice cultivation of the ancient Mariana Islanders. In *Plants and the Migrations of Pacific Peoples: A Symposium*, edited by J. Barrau, pp. 91-92. Bishop Museum Press, Honolulu.

Yen, D.E. 1991. Polynesian cultigens and cultivars: the questions of origin. In *Islands, Plants, and Polynesians: An Introduction to Polynesian Ethnobotany*, edited by P.A. Cox and S.A. Banack, pp. 67-95. Dioscorides Press, Portland, Oregon.

Zerega, N., D. Ragone and T. Motley. 2004. Complex origins of breadfruit (*Artocarpus altilis*, Moraceae): implications for human migrations in Oceania. *American Journal of Botany* 91(5):760-766.

APPENDIX A. TABLES

Table 1. Tendencies of Corporate and Network Strategies (Feinman 2000a:39, Table 3.2).

Network	Corporate
Concentrated wealth	More even wealth distribution
Individual power	Shared power arrangements
Ostentatious consumption	More balanced accumulation
Prestige goods	Control of knowledge, cognitive codes
Patron-client factions	Corporate labour systems
Attached specialization	Emphasis on food production
Wealth finance	Staple finance
Princely burials	Monumental ritual spaces
Lineal kinship systems	Segmental organizations
Power inherited through personal glorification	Power embedded in group association/ affiliation
Ostentatious elite adornment	Symbols of office
Personal glorification	Broad concerns with fertility, rain

Table 2. Potential Architectural Correlates of Dual-Processual Strategies in Earthwork Era Palau.

	Corporate	Network
Dimensions & Spatial Organization		
Distribution	dispersed; intra-settlement social segmentation; similar residential settings	cluster in a central place; in a bounded space; multimodal settlement pattern
	boundary maintenance?	boundary maintenance?
Space	public access	restricted access
Size	largest structures are public buildings, ceremonial structures, public infrastructure	largest structures are palaces or burial tombs
Relative Size	uniform	diverse sizes, a dominant structure
Construction	accretion in size over time	single construction phase of monumental proportions
Form	standardized	variability in form
Function	communal activities	individualized activities
Burial	communal cemeteries; rarity of elite burials	elaborate burials; high-status burial furniture
Defence	--	fortifications, defensive features
Habitation	little variation in size, elaboration, location	disparity in size, elaboration, prominent locations, close to resources
Cultivation	cooperative food production; emphasis on local production	small plots dedicated to elite
Ritual/ Ceremonial	communal ceremonial activities; associated with resource procurement, group ancestors, fertility	ceremonial or elite centres
Workshops	in settlements	close to ceremonial centre or elite habitation
Material Remains	equal distribution	monopoly of goods
Iconography	natural, supernatural themes	representation of individuals
Prestige Good	few status goods or equally distributed	prominent display of prestige goods
Crafts	utilitarian objects	craft specialization

Table 3. Babeldaob's Major Watersheds.

Watershed	Primary State Location	Main River	Size (km ²)	Drains Into	Sub-Watersheds
Ngeremeduu	Ngaremlengui	Ngermeskang, 15.7 km	86.3	Ngeremeduu Bay (15 km ²)	Ngermeskang, Ngatpang, Tabecheding, Ngkebeduul
Ngerdorch	Ngchesar	Ngerdorch, 14.0 km	47.4	Ngerdorch Bay	
Ngerikiil	Airai	Ngerikiil, 3.7 km	28.5	Ngerikiil Bay (3 km ³)	Ngerikiil, Ikoranges, Kmekumel, Edeng, Oikull, and Airai
Diongradid	Ngardmau	Diongradid	20.6	Diongradid Bay	
Ngerbekuu	Ngiwal	Ngerbekuu	17.0	Ngemai Bay	Ngerbekuu

Table 4. Aerial Extent of Acidic Soils in Pacific Island Volcanic Islands (after R.J. Morrison 1988)

Island Group	Extent of Acidic Soils (%)
Volcanic Soils	
American Samoa	20-40
Cook Islands	40-60
Chuuk	?
Fiji	40-50
French Polynesia	60-70
Guam	20-25
Kosrae	?
New Caledonia	40-50
Northern Marianas	20-40
Palau	80
Papua New Guinea	8-15
Pohnpei	30? (NRCS)
Solomon Islands	40-50
Tonga	5-10
Vanuatu	30-50
Wallis and Futuna	70-80
Western Samoa	10-20
Yap	?

Table 5. Babeldaob’s Major Landscape Categories, Soil Map Units and Soil Series (after NRCS 2010).

Landscape Category	Soil Map Unit	Soil Series	% in Total Survey Area
Bottomlands			17
	Mesei-Dechel-Ngersuul		5
		Mesei	35
		Dechel	34
		Ngersuul	27
		Minor	4
	Odesangel		1
		Odesangel	80
		Minor	20
	Ilachetomel-Naniak-Chia		11
		Ilachetomel	64
		Naniak Mesei	19
		Chia	15
Marine Terrace		Minor	2
			4
	Tabecheding- Ngatpang- Dystrudepts		4
		Tabecheding	34
		Ngatpang	32
		Dystrudepts Mesei	30
		Minor	4
			62
	Aimeliik-Palau		49
		Aimeliik	45
		Palau	40
		Minor	15
	Babelthuap- Ngardmau- Udorthents		8
Volcanic Uplands		Babelthuap	43
		Ngardmau	36
		Udorthents Mesei	16
		Minor	5
	Udorthents-Urban Land		1
		Udorthents	47
		Urban land	34
		Minor	19
	Ollei-Nekken		4
		Ollei	43
		Nekken	30
		Minor	27

Table 6. Chemical and Physical Properties of Prevalent Babeldaob Soil Series (written as topsoil/subsoil; after Smith and Babik 1988; Gavenda et al. 2005).

Landscape Soil Series	Soil Organic Matter (SOM) (%)	Cation Exchange Capacity (CEC)*	Nutrients (Ca, Mg, K)	pH	Aluminium Saturation (%)
Uplands					
Aimeliik	16 / 2	15 / 5	15 / 0.7	5.3 / 5.1	1 / 85
Palau	9 / 1	7 / 4	1.4 / 0.4	4.9 / 5.2	80 / 90
Babelthuab	3 / 1	1 / 0.5	0.5 / 0.2	4.9 / 5.3	60 / 80
Marine Terrace					
Tabecheding	2.3 / 0.5	9 / 16	2 / 0.6	5.0 / 5.0	35 / 94
Bottomland					
Dechel	6 / 1.5	32 / 31	16 / 12	5.4 / 5.0	22 / 27

*Effective CEC at field pH; Units are in milliequivalents per 100g soil

Table 7. Soil Property Ranges for Major Soil Groups (written as topsoil/subsoil; after Gavenda et al. 2005).

Landscape	Soil Layer	Soil Organic Matter (SOM)	Nutrient Capacity	Al-toxicity
Volcanic uplands	topsoil	high	medium	low
	forest subsoil	very low - low	low	moderate – very high
	savannah topsoil	medium	low	moderate – very high
	savannah subsoil	very low - low	very low - low	moderate – very high
	fern topsoil	low	very low - low	low - very high
	fern subsoil	very low - low	very low - low	low - very high
Marine Terraces	topsoil	low	very low - low	moderate – very high
	subsoil	very low - low	low - high	low – very high
Bottomlands	topsoil	high – very high	high – very high	low – moderate
	subsoil	low - moderate	moderate - high	low – moderate

Table 8. Babeldaob Land Cover (after Cole et al. 1987).

Land cover	Area (km ²)	% of Babeldaob Land Cover
Upland forest*	222.1	60.4
Mangrove forest	40.3	11.0
Swamp forest	16.2	4.4
Rock Island forest	1.1	0.3
Agricultural	11.9	3.2
agroforest	9.2	
plantation forest	0.2	
cropland	2.5	
Marsh	5.6	1.5
fresh water	4.5	
cultivated	1.1	
Grassland	67.3	18.3
Urban lands	1.4	0.4
Barren	1.5	0.4
Fresh water	0.2	0.1
Total	367.6	

Table 9. Prominent Plants in Babeldaob's Major Environmental Zones

Mangrove Forest	Volcanic Forest	Marsh	Savannah	Swamp Forest
<i>Acrostichum aureum</i>	<i>Alphitonia carolinensis</i>	<i>Acrostichum aureum</i>	<i>Calophyllum inophyllum</i> var. <i>wakamatsui</i>	<i>Barringtonia racemosa</i>
<i>Avicennia marina</i> subsp. <i>marina</i>	<i>Alpinia carolinensis</i>	<i>Cyperus javanicus</i>	<i>Commersonia bartramia</i>	<i>Calophyllum pelewense</i>
<i>Bruguiera gymnorhiza</i>	<i>Atuna racemosa</i> Rafin spp. <i>racemosa</i>	<i>Derris trifoliata</i>	<i>Decaspermum parviflorum</i>	<i>Campnosperma brevipetiolata</i>
<i>Ceriops tagal</i>	<i>Calophyllum inophyllum</i> L. var. <i>wakamatsui</i>	<i>Eleocharis geniculata</i>	<i>Dianella carolinensis</i>	<i>Colona scabra</i>
<i>Dalbergia candenatensis</i>	<i>Campnosperma brevipetiolata</i>	<i>Ipomoea aquatica</i>	<i>Dicranopteris linearis</i> [^]	<i>Cynometra ramiflora</i>
<i>Derris trifoliata</i>	<i>Cerbera</i> spp.	<i>Lippia nodiflora</i>	<i>Eurya japonica</i> Thun. var. <i>nitida</i>	<i>Derris trifoliata</i>
<i>Dolichandrone spathacea</i>	<i>Cyathea sphaeropteris</i> spp.	<i>Paspalum distichum</i>	<i>Hedyotis korrorensis</i> (Val.) Hosok. var. <i>korrorensis</i>	<i>Hibiscus tiliaceus</i> (disturbed areas)
<i>Excoecaria agallocha</i>	<i>Elaeocarpus joga</i>	<i>Phragmites karka</i>	<i>Hedyotis tomentosa</i>	<i>Horsfieldia irya</i>
<i>Lumnitzera littorea</i>	<i>Fragraea ksid</i>	<i>Vigna marina</i>	<i>Ischaemum polystachyum</i> *	<i>Macaranga carolinensis</i> (disturbed areas)
<i>Nephrolepis acutifolia</i>	<i>Gmelina palawensis</i>		<i>Lycopodiella cernua</i>	<i>Pandanus kanehirae</i>
<i>Nypa fruticans</i>	<i>Horsefeldia palauensis</i>		<i>Melastoma malabathricum</i> L. var. <i>marianum</i>	<i>Semecarpus venenosa</i>
<i>Rhizophora apiculata</i>	<i>Ixora casei</i>		<i>Morinda citrifolia</i>	<i>Stemonurus ammui</i>
<i>Rhizophora mucronata</i>	<i>Manilkara udoido</i>		<i>Morinda pedunculata</i>	
<i>Sonneratia alba</i>	<i>Maranthes corymbosa</i>		<i>Mussaenda frondosa</i>	
<i>Scyphiphora hydrophyllacea</i>	<i>Myristica insularis</i>		<i>Nepenthes mirabilis</i>	
<i>Shirakiopsis indicus</i>	<i>Osmoxylon oliveri</i>		<i>Pandanus tectorius</i>	
<i>Xylocarpus granatum</i>	<i>Pandanus aimiriikensis</i>		<i>Phyllanthus palauensis</i>	
	<i>Pinanga insignis</i>		<i>Pleomele multiflora</i>	
	<i>Pterocarpus indicus</i>		<i>Spathoglottis</i> spp.	
	<i>Rhus taitensis</i>		<i>Symplocos racemosa</i> var. <i>palauensis</i>	
	<i>Semecarpus venenosus</i>		<i>Timonius subauritus</i>	
	<i>Serianthes kanehirae</i> Fost. var. <i>kanehirae</i>		<i>Trichospermum ledermannii</i>	
			<i>Wikstroemia elliptica</i>	

[^] *Dicranopteris linearis* (false staghorn fern) - *Dicranopteris* is the new genus for *Gleichenia*.

* *Ischaemum polystachyum* was *Ischaemum chordatum*.

** *Lycopodiella cernua* was *Lycopodium cernuum*.

Table 10. Earthwork Elevation Intervals.

Elevation Above Mean Sea Level (m)	Earthworks (km ²)	Percent
5-10	6.71	14.6
10-25	10.99	24.0
25-50	14.90	32.5
50-75	7.01	15.3
75-100	3.20	7.0
100-125	1.45	3.2
125-150	0.91	2.0
150-175	0.62	1.3
175-200	0.12	0.3
200-214	--	--
Total	45.92	

Table 11. Earthwork Slope, Weighted Average.

Category	Percent Slope	Earthworks (km ²)	Percent
Gently Sloping	2-6	5.59	12.4
Strongly Sloping	6-12	5.94	13.0
Moderately Steep	12-20	6.99	15.2
Steep	20-50	18.85	41.1
Very Steep	50-75	8.38	18.2
Extremely steep	> 75	0.06	0.1
	Total	45.91	

^ Slope data from NRCS 2010.

Table 12. Earthworks in Geological Formations.

Geological Formation Member	Area (km ²)*	Earthworks (km ²)	Percent of Formation	Percent of Earthworks
Submember				
Babelthuap (Tb)	54.80	0.77	1.4	1.8
Aimliik	156.95	24.68	15.7	58.3
Ngardok (Tat)	38.36	7.79	20.3	18.4
Ngarsul (Tan)	118.59	16.89	14.2	39.9
Ngeremlengui (Tn)	95.83	16.86	17.6	39.8
Total	307.58	42.31		

* Calculations from geological formation map by Corwin et al. (1956). The remaining land area is composed of Airai clay, calcareous sand and alluvium.

Table 13. Earthworks in Vegetation Categories.^

Vegetation Category	Recorded Earthworks (km ²)	Recorded Earthworks (%)	Estimated Earthworks (km ²)	Estimated Earthworks (%)
Forest	24.67	53.8	42.67	66.7
Savannah	15.92	34.8	15.92	24.9
Agricultural	4.52	9.9	4.52	7.1
Other*	0.70	1.6	0.70	1.1
Total	45.83		63.91	

^ Vegetation data from Cole et al. 1987.

* Other = urban land, barren and unknown

Table 14. Earthworks in Soil Map Units.^

Landscape Category	Earthworks (km ²)	Percent
Volcanic Uplands		
Aimeliik-Palau	40.87	89.0
Ollei-Nekken	2.02	4.4
Babelthaub-Ngardmau-Udorthents	1.68	3.7
Marine Terraces		
Tabecheding-Ngatpang-Dystrudepts	1.33	2.9
Total	45.90	

^ Soil data NRCS 2010.

Table 15. Summary of Fieldwork and Laboratory Analysis.

State	Site No.	Place Name	Site Type	Strat TRs	C ¹⁴	RVs	Wood ID	Soil Analysis	Archaeo-botanical Analysis
Ngaremlengui	NM-1:1	Ongelwatel	ridgeline	3	2	1	2		
	NM-1:5	Ngeskebei	step-terrace complex	6	9		16	2	2
	NM-1:7	Sisngebang	crown complex	16	8	4	15	6	4
	NM-3:16	Ked era Aranguong	step-terrace complex	12	6		7	3	1
	NM-3:j1	Ngedel-chong	crown	1	4		5	1	1
	NM-7:j1	Nkebeduul	ridgeline	11	3		3	3	2
Melekeok	ME-4:3	Roismelech	crown complex		2	2	2		
TOTAL	7			50	34	7	48	15	10

Table 16. Reconstructable Pottery Vessels.

Provenience (cmbs)	Calibrated Age BP (2 σ)*	Context	Body / Rim Thickness (mm)	Surface & Distinguishing Treatment	Rim Form; Orientation	Vessel Form^	Diameter / Depth (cm)	Comments	Cat. No.
Sisngebang, NM-1:7, Fea. 2, 0	--	deflated surface on crown	5 / --	--	likely straight-sided; unrestricted	dish	25 / 6	upright, missing rim	223
Sisngebang, NM-1:7, TR 16, III, 20-35	ca. 1180-980 BP	surface of burial pit; on crown	10-13 / 10-34	slip (brown)	likely flange; unrestricted	bowl	51 / 25-30	upright; disturbed by subsequent burials	265, 289
Sisngebang, NM-1:7, TR 11, VI, 48	1290-1170 BP	pot cache on crown	5-9.5 / 7	paint (int./ext. brick red), incised relief, foot	straight-sided; unrestricted	bowl	28 / 12.5	upside down; re-occurring band of X's linked by central raised band; foot is 12.5 cm in diameter, 3.0 cm tall	322 (Pot 1)
			9.5 / 7.2	paint (int./ext. brick red)	straight-sided, thinning; unrestricted	bowl	26 / 11	upside down; ca. 25 % vessel missing	323 (Pot 2)
			11-13 / 7	paint (int brick red, ext.?); muddy; impressed; foot	straight-sided; unrestricted	bowl	34 / 16	upside down; V-shaped design circles middle vessel, parallel rows of oval impressions; foot ca. 1 cm & 7 mm thick; ca. 40% vessel missing	324 (Pot 3)
Roismelech, ME-4:3, ca. 400	1990-1820 BP	prepared surface covered by construction fill	8.7 by rim, 12 at curve, 11.7 base / 13.2	slip (int/ext. lt brown)	ext. thickened; restricted	bowl	orifice - 16, widest body 32.5 / 20	upright	2
			6.2-10.5 / 10.2	slip (int./ext. lt brown), raised design	straight-sided; unrestricted	bowl	orifice - 24, body - 30 / 24	upright; 5 horizontal raised bands crossing 2 vertical bands circling pot	1

Table 17. Charcoal Taxa Identification.

Provenience	Family	Taxa	Palauan (English) Name	Origin	Vegetation Community	Traditional Uses of Wood	Cat. No.
ROISMELECH, ME-4:3							
ME-4:3, Profile S, V, 350	Fabaceae	<i>Intsia bijuga</i>	<i>dort</i> (ironwood)	native	volcanic lowland forest; limestone forest, atoll, strand vegetation	construction (heavy strong wood); leaves as fertilizer to provide nitrogen	722
ME-4:3, Profile S, V, 440	Fabaceae	<i>Intsia bijuga</i>	<i>dort</i> (ironwood)	native	volcanic lowland forest; limestone forest, atoll, strand vegetation	construction (heavy strong wood); leaves as fertilizer to provide nitrogen	727
NI-2:35, TR 1, SFea. 6,	cf. Euphorbiaceae						16.2
ONGELWATEL, NM-1:1							
NM-1:1, TR 1, pot, 60	Arecaceae		Palm	native and introduction	limestone forest, atoll, strand vegetation; agroforest		88
NM-1:1, TR 1, V, 112	Moraceae	cf. <i>Artocarpus altilis</i>	<i>meduu</i> (breadfruit)	aboriginal introduction	agroforest, limestone forest, atoll, strand vegetation	medicine, boats, food (sap)	92
NGESKEBEL, NM-1:5							
NM-1:5, TR 2, SFea. 1, 130-135	Celastraceae	cf. <i>Gymnosporia palauica</i>	--	endemic	limestone forest?		68
NM-1:5, TR 4, SFea. 1, 90	Euphorbiaceae	cf. <i>Acalypha amentacea</i>	<i>klakl, klekel</i>	1 native, 1 endemic, 1 introduced	volcanic lowland forest		40
NM-1:5, TR 4, SFea. 2, 150	Moraceae	cf. <i>Artocarpus altilis</i>	<i>meduu</i> (breadfruit)	aboriginal introduction	agroforest, limestone forest, atoll, strand vegetation	medicine, boats, food (sap)	69
NM-1:5, TR 4, SFea. 6, 40	Celastraceae	cf. <i>Gymnosporia palauica</i>		endemic	limestone forest?		74
NM-1:5, TR 4, Va, 63	Monocyledon?						216
NM-1:5, TR 4, XII, 80	cf. Pteridophyta (Pteridaceae)						42
NM-1:5, TR 6, SFea. 1b, 142	Rhizophoraceae	cf. <i>Bruguiera gymnorhiza</i>	<i>kodenges</i> (oriental mangrove)	native	mangrove forest - interior, fringe, riverine	construction (resists rot and insects) - lumber, posts, poles; firewood; medicine; famine food	11
NM-1:5, TR 6, VIII, 50	Phyllanthaceae	cf. <i>Glochidium</i> sp.	<i>ngolm</i>	4 native, 1 endemic	volcanic lowland forest; limestone forest, strand vegetation	medicine	24
SISNGEBANG, NM-1:7							
NM-1:7, TR 7, IV, 62	Rhizophoraceae	cf. <i>Bruguiera gymnorhiza</i>	<i>kodenges</i> (oriental mangrove)	native	mangrove forest - interior, fringe, riverine	construction (resists rot and insects) - lumber, posts, poles; firewood; medicine; famine food	628.1

Provenience	Family	Taxa	Palauan (English) Name	Origin	Vegetation Community	Traditional Uses of Wood	Cat. No.
NM-1:7, TR 11, VI, 55	Fabaceae	<i>Intsia bijuga</i>	<i>dort</i> (ironwood)	native	volcanic lowland forest; limestone forest, atoll, strand vegetation	construction (heavy strong wood); leaves as fertilizer to provide nitrogen	635.1
NM-1:7, TR 11, VI, 55	Rhizophoraceae	cf. <i>Bruguiera gymnorhiza</i>	<i>kodenges</i> (oriental mangrove)	native	mangrove forest - interior, fringe, riverine	construction (resists rot and insects) - lumber, posts, poles; firewood; medicine; famine food	635.2
NM-1:7, TR 11, VI, 55	Anacardiaceae	cf. <i>Campnosperma brevipetiolata</i>	<i>kelelacharm</i>	native	volcanic lowland forest; freshwater swamp forest	[construction; firewood; medicine]	635.3
NM-1:7, TR 11, VI, with RVs, 50	Rhizophoraceae	cf. <i>Rhizophora</i> sp.	<i>bngaol, tebechel</i> (mangrove)	3 native	mangrove forest - fringe, riverine, interior	construction - lumber, posts, poles; fuel; charcoal; dye; medicine; bows (roots); spear handles; darts	720
NM-1:7, TR 11, VIIb, 105	Arecaceae	cf. <i>Cocos nucifera</i>	<i>lius</i> (coconut)	early introduction	agroforest, limestone forest, atoll, strand vegetation	food; drink; fiber - rope, string, nets; beauty products; construction - furniture, flooring; firewood; medicine	684
NM-1:7, TR 12, pit,	Monocyledon?						638.1
NM-1:7, TR 15, IX, 94	Rhizophoraceae	cf. <i>Bruguiera gymnorhiza</i>	<i>kodenges</i> (oriental mangrove)	native	mangrove forest - interior, fringe, riverine	construction (resists rot and insects) - lumber, posts, poles; firewood; medicine; famine food	632
NM-1:7, TR 16, B1, IV, 78	Rhizophoraceae	cf. <i>Rhizophora</i> sp.	<i>bngaol, tebechel</i> (mangrove)	3 native	mangrove forest - fringe, riverine, interior	construction - lumber, posts, poles; fuel; charcoal; dye; medicine; bows (roots); spear handles; darts	661
KED ERA ARANGUONG, NM-3:16							
NM-3:16, TR 11, IX, 104	Phyllanthaceae	cf. <i>Glochidium</i> sp.	<i>ngolm</i>	4 native, 1 endemic	volcanic lowland forest; limestone forest, strand vegetation	medicine	581
NM-3:16, TR 5, IV, 48, charcoal concentration	Arecaceae				limestone forest, atoll, strand vegetation; agroforest		694
NM-3:16, TR 8, IV, 95, base-crust	Rhizophoraceae	cf. <i>Bruguiera gymnorhiza</i>	<i>kodenges</i> (oriental mangrove)	native	mangrove forest - interior, fringe, riverine	construction (resists rot and insects) - lumber, posts, poles; firewood; medicine; famine food	603
NGEDELCHONG CROWN, NM-3:J1							
NM-3:j1, TR 13, XI, 145	Phyllanthaceae	cf. <i>Glochidium</i> sp.	<i>ngolm</i>	4 native, 1 endemic	volcanic lowland forest; limestone forest, strand vegetation	medicine	597

Provenience	Family	Taxa	Palauan (English) Name	Origin	Vegetation Community	Traditional Uses of Wood	Cat. No.
NM-3:j1, TR 13, II, 22	Fabaceae	cf. <i>Parkia parvifolia</i>	<i>kmekumer</i>	endemic	volcanic lowland forest	construction; nitrogen fixing tree	624
NM-3:j1, TR 13, V/VI, 92	Rhizophoraceae	cf. <i>Rhizophora</i> sp.	<i>bngaol, tebechel</i> (mangrove)	3 native	mangrove forest - fringe, riverine, interior	construction - lumber, posts, poles; fuel; charcoal; dye; medicine; bows (roots); spear handles; darts	621
NKEBEDUUL, NM-7:j1 NM-7:j1, TR 8, III, 20	Areaceae	<i>Cocos nucifera</i>	<i>lius</i> (coconut)	early introduction	agroforest, limestone forest, atoll, strand vegetation	food; drink; fibre - rope, string, nets; beauty products; construction - furniture, flooring; firewood; medicine	2
NM-7:j1, TR 8, III, 20	Areaceae	<i>Cocos nucifera</i>	<i>lius</i> (coconut)	early introduction	agroforest, limestone forest, atoll, strand vegetation	food; drink; fibre - rope, string, nets; beauty products; construction - furniture, flooring; firewood; medicine	2

Table 18. Radiocarbon Date Ranges.

Sample No.^	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*
ONGELWATEL, NM-1:1							
WK-27009	TR 1, V, 112	construction fill – first construction event, on cut saprolite	cf. <i>Artocarpus altilis</i>	-26.5 ± 0.2	2377 ± 30	540-380 BC (93.6%), 720-690 BC (1.8%)	2490-2330 BP (93.6%), 2670-2640 BP (1.8%)
WK-27008	TR 1, 60	pot matrix – under stone paving	Arecaceae	-28.2 ± 0.2	363 ± 30	AD 1440-1530 (49.9%), AD 1540-1640 (45.5%)	510-420 BP (49.9%), 410-310 BP (45.5%)
NGESKEBEL, NM-1:5							
WK-27003	TR 1, IV, 150	large pit matrix – cut into C horizon	Unknown 2	-25.3 ± 0.2	1234 ± 30	AD 680-880	1270-1070 BP
WK-27005	TR 2, SFea. 1, 135	small pit matrix – cut into C horizon	cf. <i>Maytenus palauica</i>	-27.0 ± 0.2	2970 ± 30	1310-1050 BC	3260-3000 BP
WK-27002	TR 4, XII, 80	intact cultural horizon	cf. <i>Pteridophyta</i>	-29.7 ± 0.2	476 ± 30	AD 1400-1460	545-495 BP
WK-27001	TR 4, SFea. 1, 90	posthole matrix	cf. <i>Acalypha amentacea</i>	-22.6 ± 0.2	240 ± 30	AD 1630-1690 (54.3%), AD 1730-1810 (29.9%), AD 1520-1560 (6.1%), AD 1930... (5.0%)	320-260 BP (54.3%), 220-140 BP (29.9%), 430-390 BP (6.1%), 20 BP... (5.0%)
WK-27006	TR 4, SFea. 2, 150	garbage pit matrix – cut into C horizon	cf. <i>Artocarpus altilis</i>	00 ± 0.2	1253 ± 30	AD 670-870	1280-1080 BP
WK-27007	TR 4, SFea. 6, 40	posthole matrix	cf. <i>Maytenus palauica</i>	-25.9 ± 0.2	356 ± 30	AD 1450-1640	500-310 BP
WK-26998	TR 6, IIIb, 70	construction fill; first construction event	cf. seed embryo	-27.6 ± 0.2	1565 ± 30	AD 420-570	1530-1380 BP
WK-26999	TR 6, VIII, 50	truncated cultural horizon	cf. <i>Glochidium</i> sp.	-27.3 ± 0.2	306 ± 30	AD 1480-1650	470-300 BP
WK-28515	TR 6, SFea. 1b, 160	small pit matrix - cut into B/C horizon	Unknown 1	00 ± 0.2	3089 ± 30	1430-1260 BC	3380-3210 BP
Abandoned - too small							
WK-28514	TR 2, IV, 70	surface before first construction phase	--				
WK-27004	TR 4, XV, 120	lower living surface	Unknown 3 (Set 1)				
WK-27000	TR 6, SFea. 1b, 145	small pit matrix	Unknown 2 (Set 1)				
SISNGBANG, NM-1:7							
WK-28517	TR 3, III, 52	intact cultural horizon	Unknown 1 (Set 2)	-26.6 ± 0.2	1159 ± 30	AD 770-970	1180-980 BP
WK-28518	TR 7, IV, 62	intact cultural horizon	cf. <i>Bruguiera gymnorrhiza</i>	-26.2 ± 0.2	2588 ± 30	820-750 BC (86.2%), 690-660 BC (6.5%), 640-590	2770-2700 BP (86.2%), 2640-2610 BP (6.5%), 2590-2540

Sample No.^	Provenience (cmbs)	Context	Sample Material	$^{13}\text{C}/^{12}\text{C}$ Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*
WK-28519	TR 8, VIII, 98	small pit matrix, cut into saprolite	Unknown 3	-25.6 \pm 0.2	1320 \pm 30	BC (2.7%) AD 650-780	BP (2.7%) 1300-1170 BP
WK-28521	TR 11, VI, 55	in pot cache	<i>Intsia bijuga</i>	-26.1 \pm 0.2	1296 \pm 30	AD 660-780	1290-1170 BP
WK-28520	TR 11, VIIb, 105	pit matrix – ceremonial cultivation?	cf. <i>Cocos nucifera</i>	-26.9 \pm 0.2	1752 \pm 30	AD 210-390	1740-1560 BP
WK-28522	TR 15, VI, 100	basin - pit matrix – ceremonial cultivation?	Unknown 3	-26.3 \pm 0.2	1438 \pm 30	AD 560-660	1385-1295 BP
WK-28523	TR 15, IX, 94	basin - central pit matrix – ceremonial cultivation	cf. <i>Bruguiera gymnorhiza</i>	-26.4 \pm 0.2	1246 \pm 30	AD 680-880	1270-1080 BP
WK-28524	TR 16, B1, IV, 80	burial pit	cf. <i>Rhizophora</i> sp.	-25.2 \pm 0.2	1179 \pm 30	AD 770-970	1180-980 BP
KED ERA ARANGUONG, NM-3:16							
WK-28525	TR 2, SFea. 1, 85	floor of large pit	Unknown 5	-24.3 \pm 0.2	2048 \pm 30	170 BC-AD 30	2120-1920 BP
WK-28526	TR 5, II, 30	upper intact living surface	Unknown 1 (Set 2)	-25.9 \pm 0.2	776 \pm 30	AD 1210-1290	735-670 BP
WK-28527	TR 5, IV, 48	burn event in lower intact living surface	Arecaceae	-26.0 \pm 0.2	1719 \pm 30	AD 240-400	1710-1550 BP
WK-28528	TR 8, IV, 95	matrix in base of large pit, associated with lens of pottery sherds	cf. <i>Bruguiera gymnorhiza</i>	-25.4 \pm 0.2	1808 \pm 30	AD 120-260 (88%), AD 280-330 (7.4%)	1830-1690 BP (88%), 1670-1620 BP (7.4%)
WK-28529	TR 9, SFea. 2, 110	erosional fill in water control ditch	Unknown 2	-26.4 \pm 0.2	1460 \pm 30	AD 540-650	1400-1300 BP
WK-28530	TR 11, IX, 104	basal erosional layer in anthropogenic gully	cf. <i>Glochidium</i> sp.	-25.4 \pm 0.2	2411 \pm 30	550-390 BC (80.8%), 740-680 BC (12%), 670-640 BC (2.6%)	2500-2340 BP (80.8%), 2690-2630 BP (12%), 2620-2590 BP (2.6%)
NGEDELCHONG CROWN, NM-3:J1							
WK-28533	TR 1, II, 22	top of crown – intact cultural deposit	cf. <i>Parkia parvifolia</i>	-26.5 \pm 0.2	312 \pm 30	AD 1480-1650	470-300 BP
WK-28531	TR 1, V, 92	base of basin	cf. <i>Rhizophora</i> sp.	-24.0 \pm 0.2	2037 \pm 30	170 BC-AD 50	2120-1900 BP
WK-28532	TR 1, XI, 145	pit matrix associated with lens of pottery sherds	cf. <i>Glochidium</i> sp.	-23.7 \pm 0.2	1895 \pm 30	AD 50-220	1900-1730 BP
WK-28534	TR 1, XII, 184	small pit cut into saprolite, base of larger pit	Unknown 1	-26.7 \pm 0.2	1995 \pm 30	60 BC-AD 80	2010-1870 BP
NKEBEDUUL, NM-7:J1							
WK-26997	TR 8, III, 20	anomalous date	Unknown 1	-26.2 \pm 0.2	2355 \pm 30	520-370 BC	2470-2330 BP
WK-28516	TR 8, III, 20	cultivation deposit	<i>Cocos nucifera</i>	-23.5 \pm 0.2	647 \pm 30	AD 1280-1400	670-550 BP
WK-27010	TR 9, SFea. 2, 75	large pit matrix (water control	Unknown 4	-29.0 \pm 0.2	1205 \pm 30	AD 760-900 (86.1%), AD	1190-1050 BP (86.1%), 1260-

Sample No.^	Provenience (cmbs)	Context	Sample Material	$^{13}\text{C}/^{12}\text{C}$ Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*
		ditch)				700-750 (9.3%)	1200 BP (9.3%)
ROISMELECH, ME-4:3							
WK-29178	Profile, V, 350	intact occupational surface	<i>Intsia bijuga</i>	-24.9 ± 0.2	1947 ± 32	50 BC-AD 90 (93.1%), AD 100-120 (2.3%)	2000-1860 (93.1%), 1850- 1830 BP (2.3%)
WK-29179	Profile, V, 440	intact occupational surface	<i>Intsia bijuga</i>	-25.1 ± 0.2	1966 ± 32	40 BC-AD 130	1990-1820 BP

* Calibrated using OxCal v. 3.10 software (Bronk Ramsey 2005, atmospheric data from Reimer et al. 2004) at two standard deviations (95.4% probability) using the Intcal04 calibration curve.

Table 19. Chemical Soil Analysis.

Provenience	pH	% OM	K (ppm)	Ca (ppm)	MG (ppm)	P (ppm)	% Total N	% Total C	% Sand	% Silt	% Clay	Cat No.
Ngeskebei (NM-1:5)												
TR 2, SFea. 1, 130-135	5.18	2.11	2.99	11.08	6.74	1.85	0.08	1.52	25.00	24.44	50.56	164
TR 6, SFea. 1b, 152	5.14	1.10	4.34	36.61	7.30	1.71	0.07	0.90	29.00	20.44	50.56	195
Sisngembang (NM-1:7)												
TR 3, III, 45-50	4.88	1.57	4.19	8.10	2.00	1.85	0.05	0.81	17.00	30.08	52.92	520
TR 8, VIII, 103-108	4.97	0.94	3.16	22.46	5.05	9.59	0.04	0.54	31.00	32.08	36.92	494
TR 11, VIIb, 110-115	5.15	2.11	1.69	31.23	18.28	1.71	0.08	1.35	35.00	28.08	36.92	509
TR 12, pit, 90	5.16	2.90	2.78	10.49	8.95	1.45	0.08	1.80	35.00	34.08	30.92	516
TR 15, VI, 100-105	5.17	3.76	1.60	9.75	1.72	3.12	0.11	2.20	37.00	38.08	24.92	512
TR 15, IX, 120-125	5.02	2.04	1.80	13.94	4.92	2.97	0.07	1.16	41.00	36.08	22.92	500
Ked era Aranguong (NM-3:16)												
TR 2, SFea. 1, 80-85 (base)	5.01	1.33	5.00	9.45	1.00	1.58	0.04	0.74	23.00	20.44	56.56	483
TR 5, IV, 55-60	4.96	2.74	2.64	10.37	0.79	2.25	0.08	1.61	19.00	18.44	62.56	486
TR 9, SFea. 2, 115-120	5.01	1.64	4.17	11.20	0.92	2.39	0.06	0.97	29.00	16.44	54.56	481
Ngedelchong Crown (NM-3:j1)												
TR 13, IV, 80-85	5.09	2.27	3.11	22.44	3.00	2.12	0.07	1.47	21.00	22.08	56.92	463
Nkebeduul (NM-7:j1)												
TR 8, II, 115-20	5.11	5.48	4.01	10.02	6.20	2.53	0.19	3.39	21.00	32.44	46.56	152
TR 8, III, 22-24	5.00	3.21	2.90	6.45	3.05	1.98	0.11	1.95	-	-	-	153
TR 9, SFea. 2, 70-75	5.05	1.80	2.68	84.23	4.30	1.85	0.06	1.09	11.00	24.44	64.56	157

Adequate or optimum levels for cultivation in dryland soils: pH 5.5-7; % OM +4.5; K 101-150 ppm; Ca 801-1200 ppm; MG 101-200 ppm; P 31-60 ppm (Ragus 1997).

Table 20. Soil Description.

Provenience	Munsell	2010 Soil Type_Subtype	Associated 14C	Interpretation	Archaeo-botanical ID	Cat No.
Ngeskebei (NM-1:5)						
TR 2, SFea. 1, 130-135	7.5YR 4/6 strong brown	638_Palau silt loam, 30-50 percent slope	1310-1050 WK-27005)	ag pit cut into saprolite	cf. <i>Maytenus palauica</i>	164
TR 6, SFea. 1b, 152	5YR 4/6 yellowish red	638_Palau silt loam, 30-50 percent slope		ag pit cut into saprolite		195
Sisngembang (NM-1:7)						
TR 3, III, 45-50	7.5YR 4/4 brown	661_Ollei-Nekken complex, lower fertility, 50-70 percent slope		ag or living surface		520
TR 8, VIII, 103-108	5YR 3/3 dark reddish brown	661_Ollei-Nekken complex, lower fertility, 50-70 percent slope		living surface? Or construction fill from living surface		494
TR 11, VIIb, 110-115	7.5YR 2.5/2 very dark brown	659_Nekken-Ollei complex, lower fertility, 12-30 percent slope		dark moist, wide pit on saprolite		509
TR 12, pit, 90	7.5YR 3/3 dark brown	659_Nekken-Ollei complex, lower fertility, 12-30 percent slope		small pit (40cm diam; min, 70cm deep)		516
TR 15, VI, 100-105	7.5YR 3/4 dark brown	659_Nekken-Ollei complex, lower fertility, 12-30 percent slope		dark moist, wide pit cut into saprolite		512
TR 15, IX, 120-125	7.5YR 4/4 brown	659_Nekken-Ollei complex, lower fertility, 12-30 percent slope		dark moist, wide pit cut into saprolite		500
Ked era Aranguong (NM-3:16)						
TR 2, SFea. 1, 80-85 (base)	10YR 3/6 dark yellowish brown	636_Palau silty clay loam, 6-12 percent slope		drainage ditch?		483
TR 5, IV, 55-60	7.5YR 4/6 strong brown	636_Palau silty clay loam, 6-12 percent slope		living surface		486
TR 9, SFea. 2, 115-120	5YR 4/6 yellowish red	635_Palau silt loam, 2-6 percent slope		drainage/irrigation channel?		481
Ngedelchong Crown (NM-3:j1)						
TR 13, IV, 80-85	7.5YR 5/6 strong brown	604_Aimeliik silt loam, 50-75 percent slope		gleyed surface in depression		463
Nkebeduul (NM-7:j1)						
TR 8, II, 115-20	7.5YR 5/6 strong brown	613_Babelthuap-Ngardmau-Typic Udorthents undifferentiated group, 6-12 percent slopes		Japanese ag?		152

Provenience	Munsell	2010 Soil Type_Subtype	Associated 14C	Interpretation	Archaeo-botanical ID	Cat No.
TR 8, III, 22-24	7.5YR 6/8 reddish yellow	613_Babelthuap-Ngardmau-Typic Udorthents undifferentiated group, 6-12 percent slopes	520-370 BC (WK-26997)	prehistoric ag?	Unknown 1 (wood)	153
TR 9, SFea. 2, 70-75	5YR 4/6 yellowish red	613_Babelthuap-Ngardmau-Typic Udorthents undifferentiated group, 6-12 percent slopes	AD760-900 (86.1%), AD 700-750 (9.3%) (WK27010)	drainage/irrigation channel?	Unknown 4, burl	157

Table 21. Archaeobotanical Analysis.

Cat. No.	Provenience (cmbs)	Context	Archeobotanical Analysis
163	NM-1:5, TR 2, SFea. 1, 120-125	Probable ag pit cut into saprolite	no pollen
196	NM-1:5, TR 6, SFea. 1b, 150-155	Probable ag pit cut into saprolite	no pollen
493	NM-1:7, TR 8, VIII, 100-105	living surface? Or construction fill from living surface	no pollen
508	NM-1:7, TR 11, VIIb, base (Sample 2), 115-120	dark moist soil, wide pit on saprolite, on crown, ag?	no pollen
511	NM-1:7, TR 15, VI, 100-105	dark moist soil, wide pit on saprolite, on crown, ag?	no pollen
501	NM-1:7, TR 15, XI, 98-105	dark moist soil, wide pit on saprolite, on crown, ag?	no pollen
479	NM-3:16, TR 9, SFea. 2, 90-95	drainage/irrigation channel? In likely ag terraces	pollen assemblage – waiting analysis
462	NM-3:j1, TR 13, IV, 80-85	gleyed surface in depression (on crown)	pollen assemblage – waiting analysis
153	NM-7:j1, TR 8, III, 22-24	prehistoric ag? Japanese ag layer directly above	pollen assemblage – dropped from analysis
158	NM-7:j1, TR 9, SFea. 2, 50-55	drainage/irrigation channel? In likely ag terraces	pollen assemblage – waiting analysis

Table 22. Cultural Sequence Model for Palau.^

Time Period	Date (cal)	Paleoenvironment	Earthworks	Settlement Pattern	Subsistence Economy	Socio-cultural	Material Culture*
Expansion Era	ca. 3100-2400 BP	savannah expansion; forest decline	none recorded; potentially step-terrace construction on coastal slopes at end of era	coastal settlement; inland use for horticulture, resource procurement, transportation, & various lookout, communication, & ceremonial capacities	swidden & wetland cultivation	population growth; limestone cave burials	pottery = generally thin bodies (≤ 5 mm), sand temper, black paste; coiled, footed base
Earthwork Era	ca. 2400-1100 BP	savannah expansion; forest decline; coastal sedimentation generated by inland earth-moving	growth, zenith, decline of large, interior earthwork districts; primary function – symbolize power of chiefs & districts; components multifunctional—boundary markers, horticulture, irrigation, habitation, defence, ritual, burials, trails, drainage	intensive interior settlement; coastal settlement & cultivation in viable locations; Rock Islands semi-permanently then permanently occupied	likely mixed dryland cultivation & arboriculture; some wetland fields; breadfruit significant?	extensive clusters of inland earth architecture form fortified sociopolitical districts; warfare; hierarchical structure; burials in Rock Island caves, step-terraces, & crowns	pottery = most grog temper; carbonaceous clay; reduced firing atmosphere; bowls—oval, round, shallow, globular, & collared; straight-sided & interior-thickened rims; few simple geometric designs – paint, incising, impressions; average body thickness 7.5-10.5 mm; whole pots in ritual contexts. abundant flake stone tools; basalt adzes; shell, bone (likely wood) tools present
Early	ca. 2400-2150 BP	largely savannah landscape; abrupt transitions from wetland to upland sediments	earth construction begins, particularly step-terraces, modified ridgelines, hills, & earth platforms	shift to focus on interior settlement; earthworks; Rock Islands semi-permanently inhabited	shifting cultivation; mixed gardening?	elite or ceremonial centres - pottery caches/whole vessels under/in construction fill; limestone cave burials	bowls-shallow & globular; back-curving & straight-sided rims; red & brown slip; burnishing; nubbins
Time Period	Date (cal)	Paleoenvironment	Earthworks	Settlement Pattern	Subsistence Economy	Socio-cultural	Material Culture*

Middle	ca. 2150-1500 BP	continuation of savannah	expansive earthworks clusters; large structures; hilltops elevated into crowns; zenith & abandonment of northeast Babeldaob's districts	sociopolitical districts extend from coast to central ridge; defined by earthworks clusters; separated by unshaped terrain; settlement areas widely dispersed in districts; Rock Island & likely coastal occupation	irrigation of interior fields; some coastal pondfields	ritual activity - structured burial sets w/ burial furniture; warfare; monumental architecture in form of massive and extensive earthworks	slip & burnishing through 1st half of phase; straight-sided & interior thickened rims; grog temper; paired small piercings close to rim; bands of reddish paint
Late	ca. 1500-1100 BP	continuation of savannah	minor construction of inland earthworks beyond older large district boundaries; crown construction intensifies decline of large interior districts	gradual movement out of interior focused districts; Rock Island & likely coastal occupation	inland cultivation continues after district decline	chiefly interments in crowns; rise in conflict identified in ring-ditch palisades & larger defensive/symbolic features	tendency toward thicker vessel walls; slightly more frequent incising
Transitional Era	ca. 1100-700 BP	forest expansion; savannah decline	limited use of largely abandoned once powerful districts; small groups of low crowns and step-terraces constructed outside of the older large districts	sharp drop in interior occupation; little documented activity on Babeldaob's coast; settlements on Rock Islands & Peleliu; villages on slopes of lowland earthworks?	some interior cultivation in irrigated fields; potential overharvesting of some inshore marine resources	decline in limestone cave burials; little evidence for cultural activity throughout archipelago	bowls predominate; potential incised human figures; thickened & flanged rims begin; greater reliance on bone, wood, and shell tools?
Stonework Era	ca. 700-150 BP	forest expansion; savannah decline	step-terraces as structural foundations for coastal villages & associated dryland fields; ancient terraces flanking coastal settlements integrated into coastal village defences & ritual activity; interior used for paths, communication, lookouts, resource procurement, ritual	compact complexes of coastal villages behind a defensive barrier of mangrove forests or swamplands & bounded by wet- and dryland agricultural fields; Rock Island villages abandoned pre-150 BP	taro cultivated in pondfield complexes; some dryland agriculture	monumental architecture in form of massive and elaborate stone architecture; warfare; complex hierarchical structure	oxidized vessels; deep, straight-sided jars, open bowls, plates, dishes; addition of some white, grey, or pink colored paste; thickened & flanged rims; decoration scarce - bands of red paint; greater reliance on bone, wood, shell tools with less stone implements

^ After Liston 2009, 2011a.

* Ceramic attributes highly varied throughout the sequence

Table 23. Agricultural Crops Suitable to Babeldaob Soils (after Smith 1983).

Soil Series	Crops
Volcanic Uplands	
Aimeliik-Palau	Agroforestry: coconut, mango, banana, papaya, guava, cassava, yams, pineapple, dryland taro and vegetable crops
Babelthuap-Ngardmau	Suitable for crops only if special management used
Bottomlands	
Ilachetomel	Not suitable for crops
Mesei-Dechel	Wetland taro, rice
Ngersuul	Bananas, cassava, coconuts, guava, mangosteens, sweet potatoes, and dryland taro
Marine Terraces	
Ngatpang	Agroforestry: coconut, mango, banana, papaya, guava, cassava, yams pineapple, dryland taro and vegetable crops
Tabecheding	Suitable for some crops only if special management used

Table 24. Taro corm yields in three cultivation systems in Palau in kg/ha*. (adapted from Del Rosario and Esguerra 2003:25)

Variety	Dryland (Sers)	Dechel (no soil additives)	Dechel (with soil additives)	Pondfield (Mesei)
Ngesuas	12,158	666	5,272	9,683
Terrekakl	8,588	1,448	6,345	3,026
Dungersuul	7,037	1,333	8,608	5,917
Ungil Dil	6,263	1,665	5,685	968
Ngemekeang	6,052	3,147	9,502	807
Ochab	5,796	1,625	4,286	1,883
Homusted	4,517	1,614	4,438	2,421
Terebkul	4,056	1,367	5,603	4,034
Kirang Redil	3,631	2,401	7,262	4,841

*These yields were produced with inorganic fertilizer.

Table 25. Vessels with Ritual Association in Earthwork Sites.

Provenience	Age Range	Vessel Description^	Cat. No.	Context	Source
No Associated Date					
Sisngebang, NM-1:7, Fea. 2, 0		dish, unrestricted	223	upright, whole, deflated surface on crown	Liston Thesis
Probably Dates to 2000+ BP					
Ngebars Earthworks NT-3:10, Profile 4, SFea. 6		bowl, slip or paint	1214	whole pot upright, in pit?	Liston 2011b
Ngebars Earthworks NT-3:10, Profile 4, SFea. 4, SSFea. 1		bowl, slip	123.0	upright partial pot in small pit	Liston 2011b
Tabelmeduu, NA-4:15, Feature 4 (earth platform)	2330-1990 calBP (WK-8297)		--	10 ceramic caches, ½ half in stone facing on saprolite base, ½ in construction fill	Tuggle 2011
2050-1800 BP					
Roismelech, ME-4:3, ca. 400	1990-1820 calBP (WK-29179)	restricted bowl, unrestricted bowl, 1 w/ banded design, brown slip	1.0, 2.0	upright whole pots plus sherds on prepared coral lined surface under construction fill; 2 of 3 pots reconstructed	Liston Thesis
Toimeduu Earthworks, NA-4:12, Fea. 3 (terrace extension)	2130-1730 calBP	bowls		2 construction layers with 9 caches and 13 primary vessels	Tuggle 2011
Toimeduu Earthworks, NA-4:12, Fea. 8 (deep step-terrace)	1970-1690 calBP	dish (n=1), slip	12.10, 13.0	shallow pit elaborate construction sequence, (capped by cobbles, burn event, sediment)	Liston and Rieth 2011
		oval plate (n=2), perforated	1059.0, 1062.0	upright, intact vessels on small stone paving	
		oval plate (n=1), painted	10.0	upright, intact vessel on deflated surface	
Rois Terraces, NA-4:6, SFea. A & B	2150-1700 BP	round bowls (n=2); oval dish (n=1), perforations	77.1, 77.2, 78	whole pots in pits cut into saprolite between burial pits; 1 pit has oval vessel, other pit has 1 upright bowl with other bowl placed upside down on it	Tuggle 2007
Tabelmeduu, NA-4:15, Feature 1 (earth platform)	ca. 2120-1820 calBP (WK-8282)	many deep bowls		16 caches, 1 of which had 20 vessels, 9 others containing >1 vessel	Tuggle 2011
	2330 to 1720 calBP (4 ¹⁴ C dates)		--	9 caches with 1 to 6 pots in each, caches associated with each of the construction layers	Tuggle 2011
	ca. 2100-1900 BP	bowls (n=14)	1, 29, 134	Pot Cache 1 - in pit ringed by charcoal stained clay; covered by construction fill; partial pots broken before placed in pit; also contained burnishing stone, ironstone cobble, CCS flakes	Liston 2008
Tabelmeduu, NA-4:15, Feature 6 (earth platform)	ca. 2100-1900 BP	bowl (n=2)	130, 131	SFea. 6 - prepared surface buried by construction fill; 1 pot turned upside down on the other; associated with a deep rock filled pit	Liston 2008

Provenience	Age Range	Vessel Description^	Cat. No.	Context	Source
	ca. 2100-1900 BP	bowl	21	whole, deliberately placed face up in construction fill matrix	Liston 2008
Ridgeline Settlement, NI-1:4, Fea. 6 (earth platform)	ca. 2050-1800 BP	globular dish (n=2), globular bowl (n=3), globular vessel (n=2), slip	156.1,162.1, 164.2, 229.1 231.0, 234.0, 235.0	pot cache (n=7); deflated surface on saprolite, pit not identifiable	Liston 2011b
		globular bowl	201.0	intentionally placed next to cobble bounding platform construction fill	
		necked globular bowl	190.0	intentionally placed as 1/2 pot in pit capped by burn lens and stone mound	
1800-1600 BP					
Ridgeline Settlement NI-1:4, Fea. 7	ca. 1800-1600 BP		169	partial pot upside down over stone in small pit	Liston 2011b
Ridgeline Settlement, NI-2a, Fea. 4, TR 4/9	ca. 1800-1600 BP	plate (n=2), dish (n=2), bowl (n=1), slip, banding	288.0, 291.1, 293.0, 294.0, 295.0, 296.0, 297.0, 298.0, 354.0, 365.0	pot cache? (n=10)	Liston 2011b
Mesesuiuil Ridgeline Settlement NA-4a, Fea. 3,	ca. 1830-1610 calBP (WK-14071)	dish or plate, paint?, slip	985.1	whole pot in posthole	Liston and Rieth 2011
	ca. 1900-1700 BP	dish, slip	1547.1	partial pot upright in small pit in construction event	Liston and Rieth 2011
Tabelmeduu Ridgeline NA-4:15, Profile 4, Fill B	1900-1700 calBP (WK-14078)	pinch pot, paint?, slip	1637.3	upright pot in pit; likely was whole, potential burial pit?	Liston and Rieth 2011
1300-1000 BP					
Sisngembang, NM-1:7, TR 11, VI, 48	1290-1170 calBP	bowls (n=3), brick red paint; incised, impressed, annular base (n=2)	322, 323, 324	pot cache on crown; upside down partial pots plus few sherds	Liston Thesis
Sisngembang, NM-1:7, TR 16, III, 20-35	ca. 1180-980 calBP	bowl (n=1), unrestricted, large	265, 289	surface of burial pit; on crown; upright; disturbed by subsequent burials	Liston Thesis

[^] All vessels are round unless stated otherwise

APPENDIX B. FIGURES

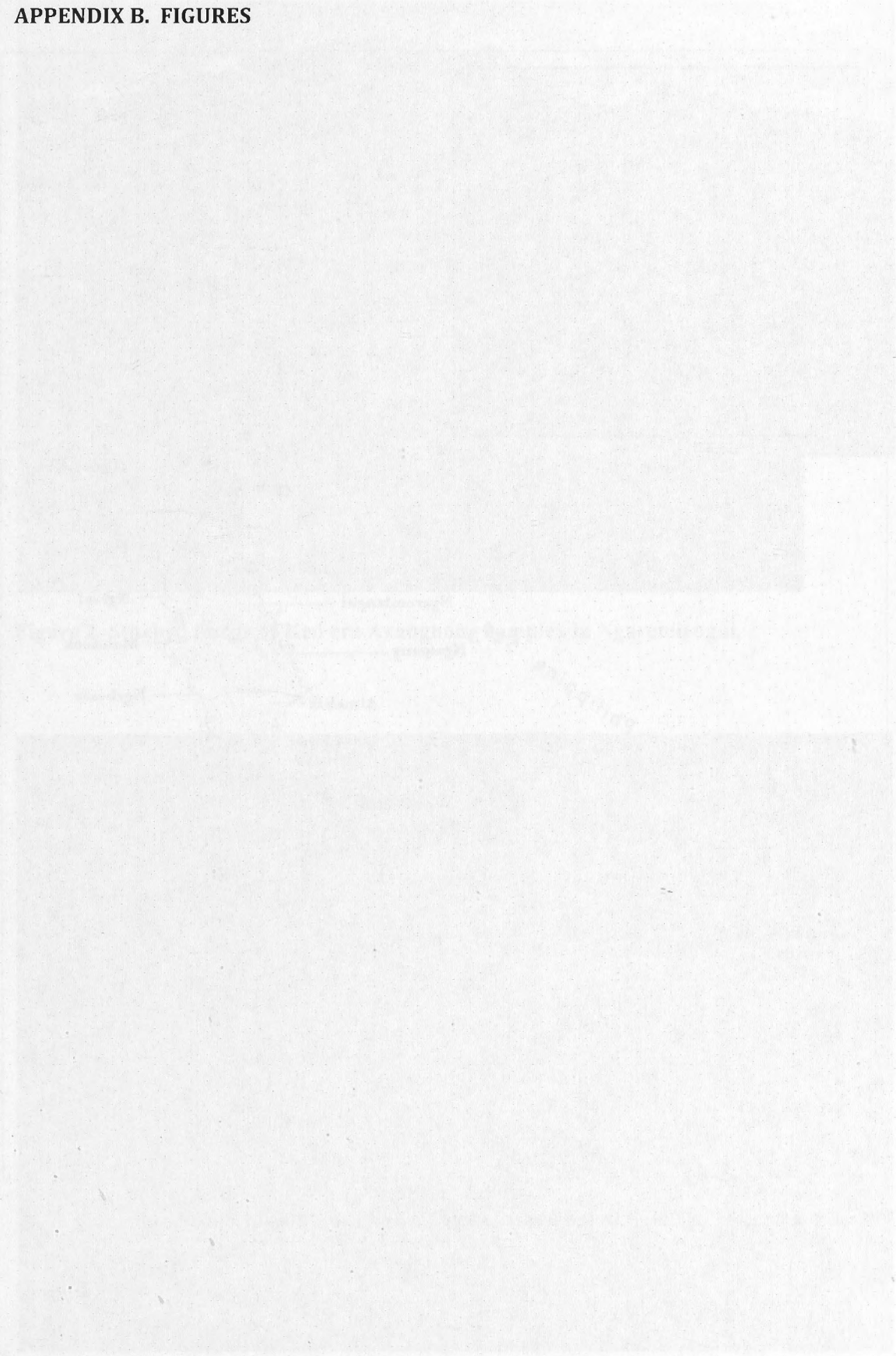


Figure 1. Crown slip surface and subsurface in Atlantic, Pacific and Gulf of Mexico

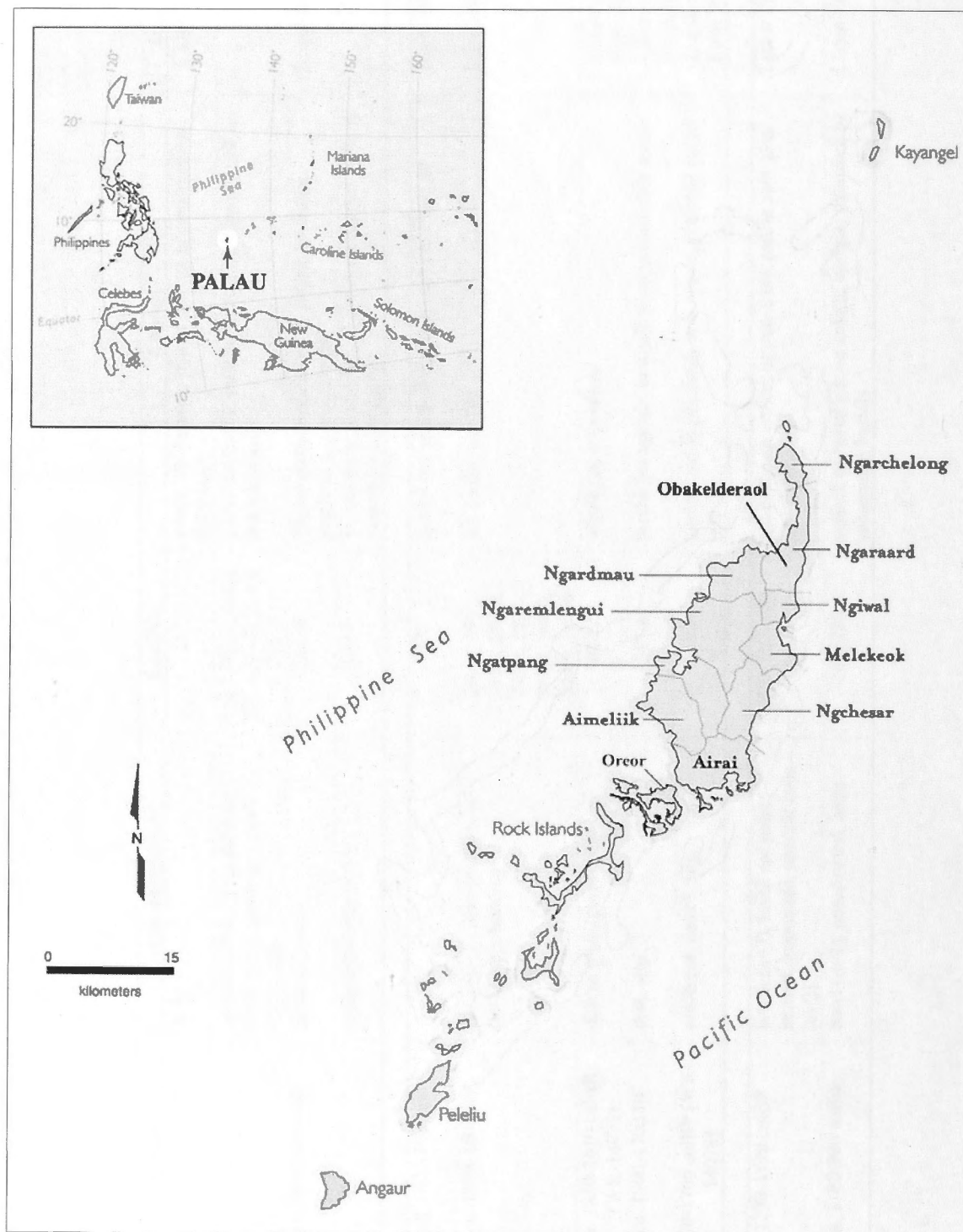


Figure 1. Location of Palau in the western Pacific and the states in Babeldaob.



Figure 2. Stitched image of Ked era Aranguong complex in Ngaremlengui.



Figure 3. Crown, step-terrace and gully complex in Aimeliik. Photo by Pat Colin.



Figure 4. Aerial view of earthwork complexes in Aimeliik Earthwork District (1976-6-2, 3).

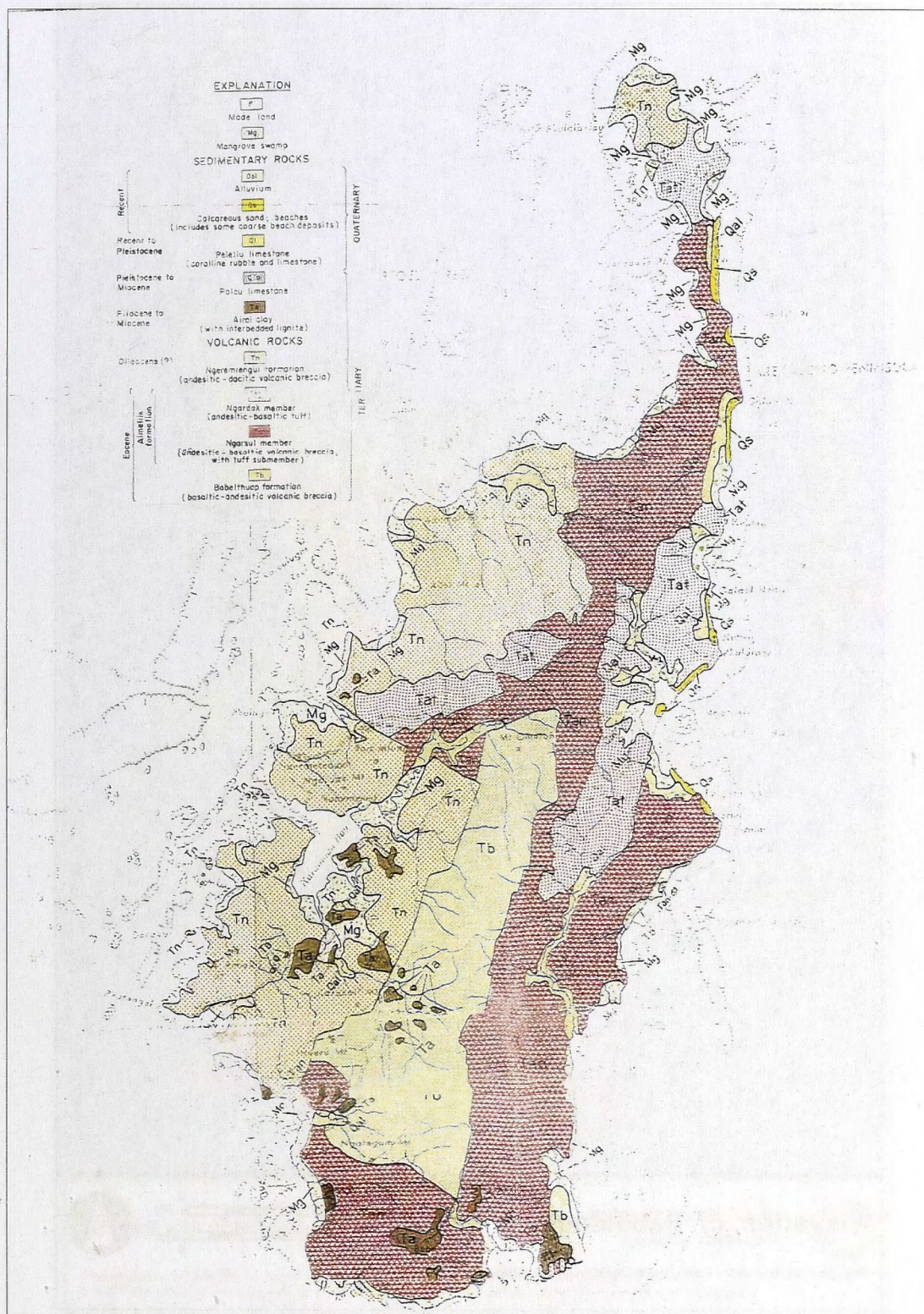


Figure 5. Geological map of Babeldaob (after Corwin et al. 1956).

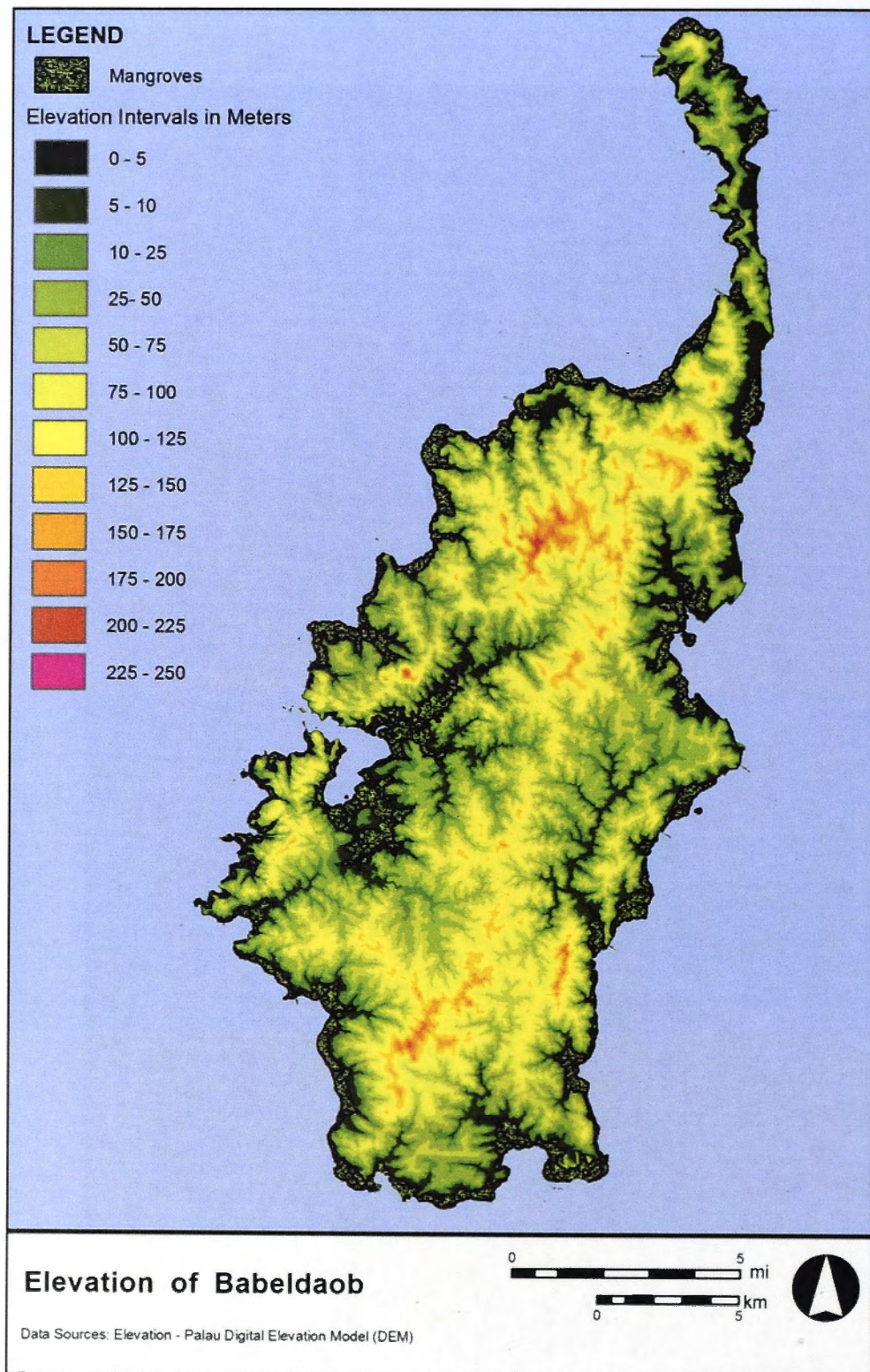


Figure 6. Elevation range on Babeldaob.

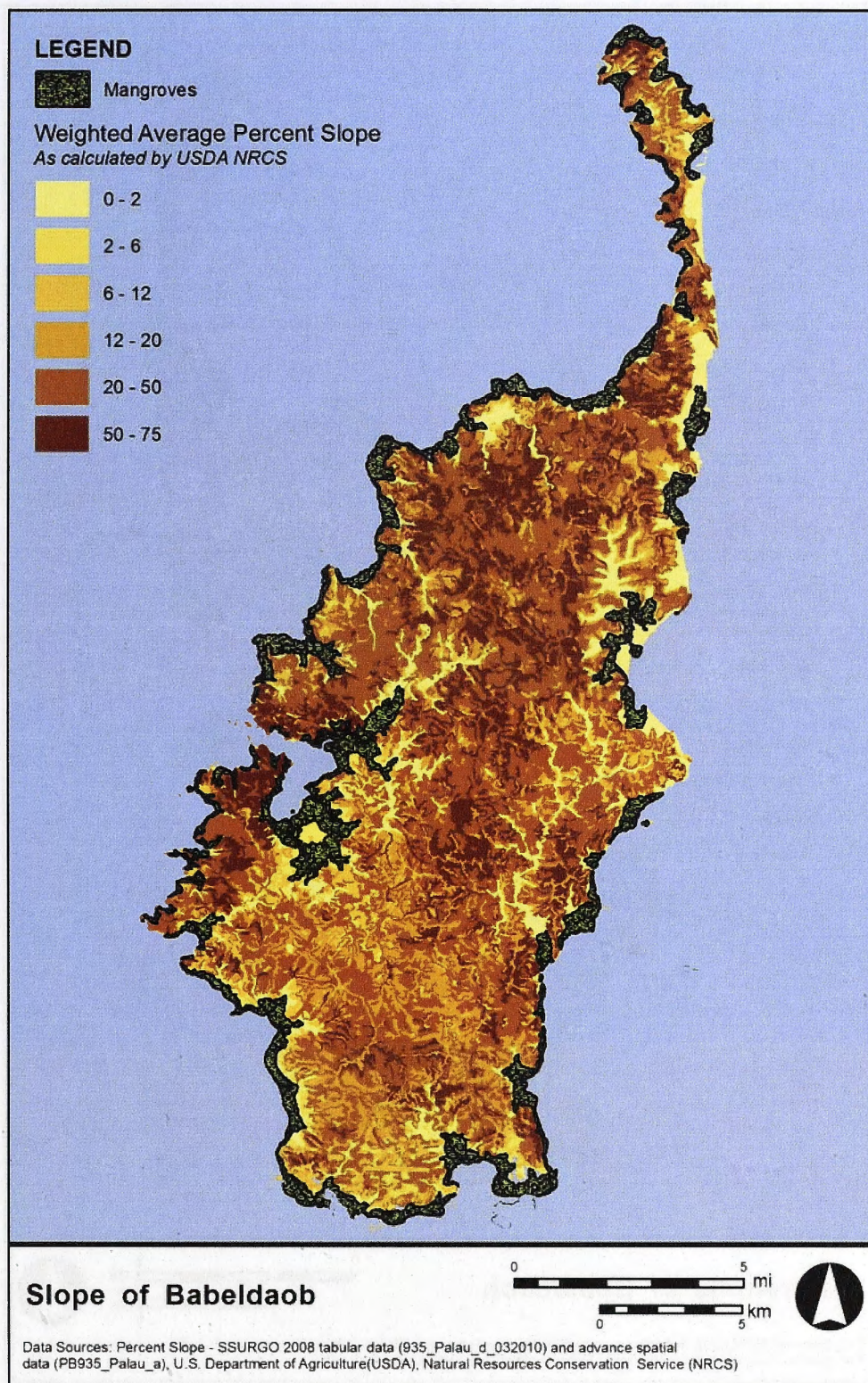


Figure 7. Weighted average percent slope on Babeldaob.



Figure 8. Watersheds in Babeldaob.

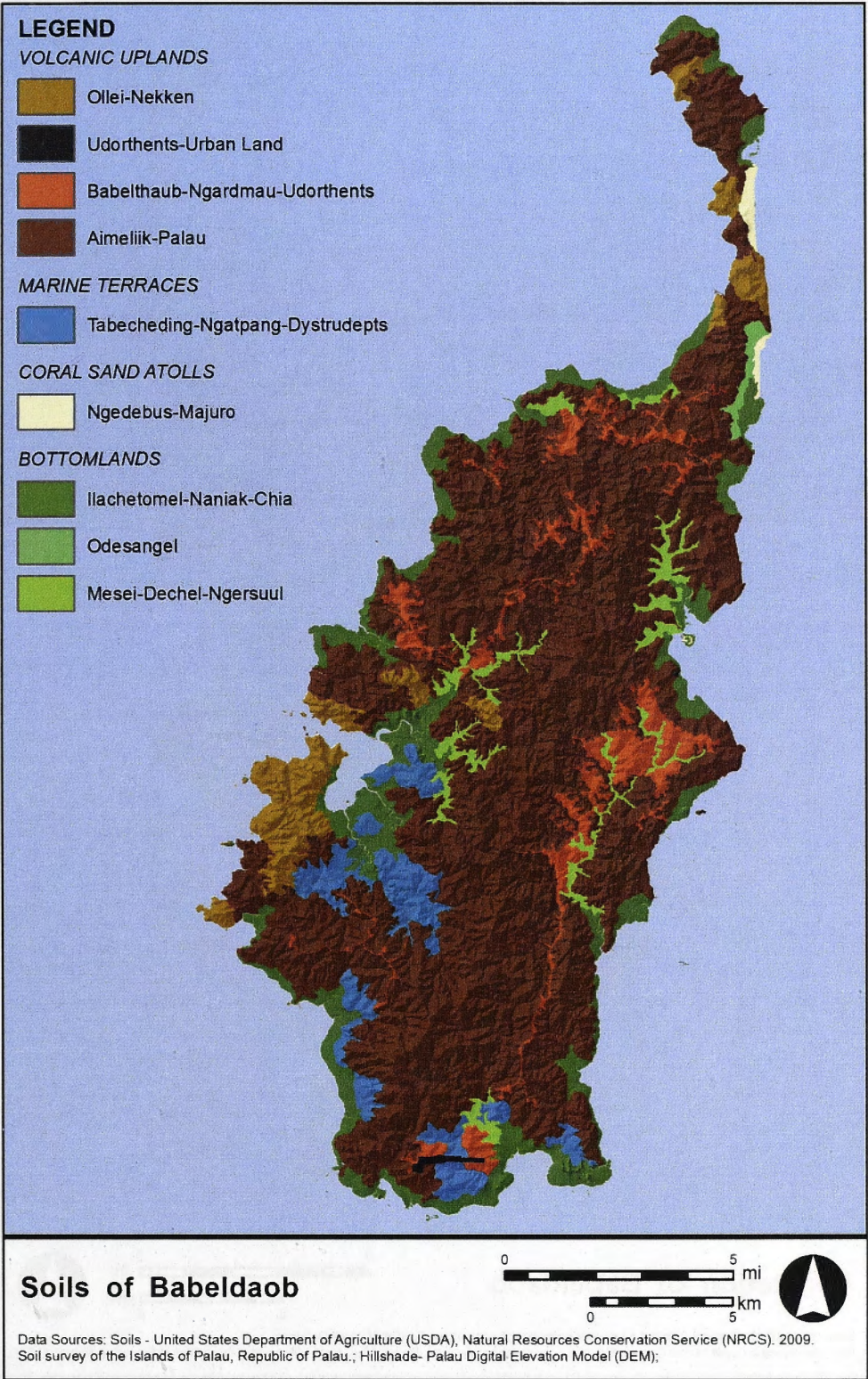


Figure 9. Soils on Babeldaob.

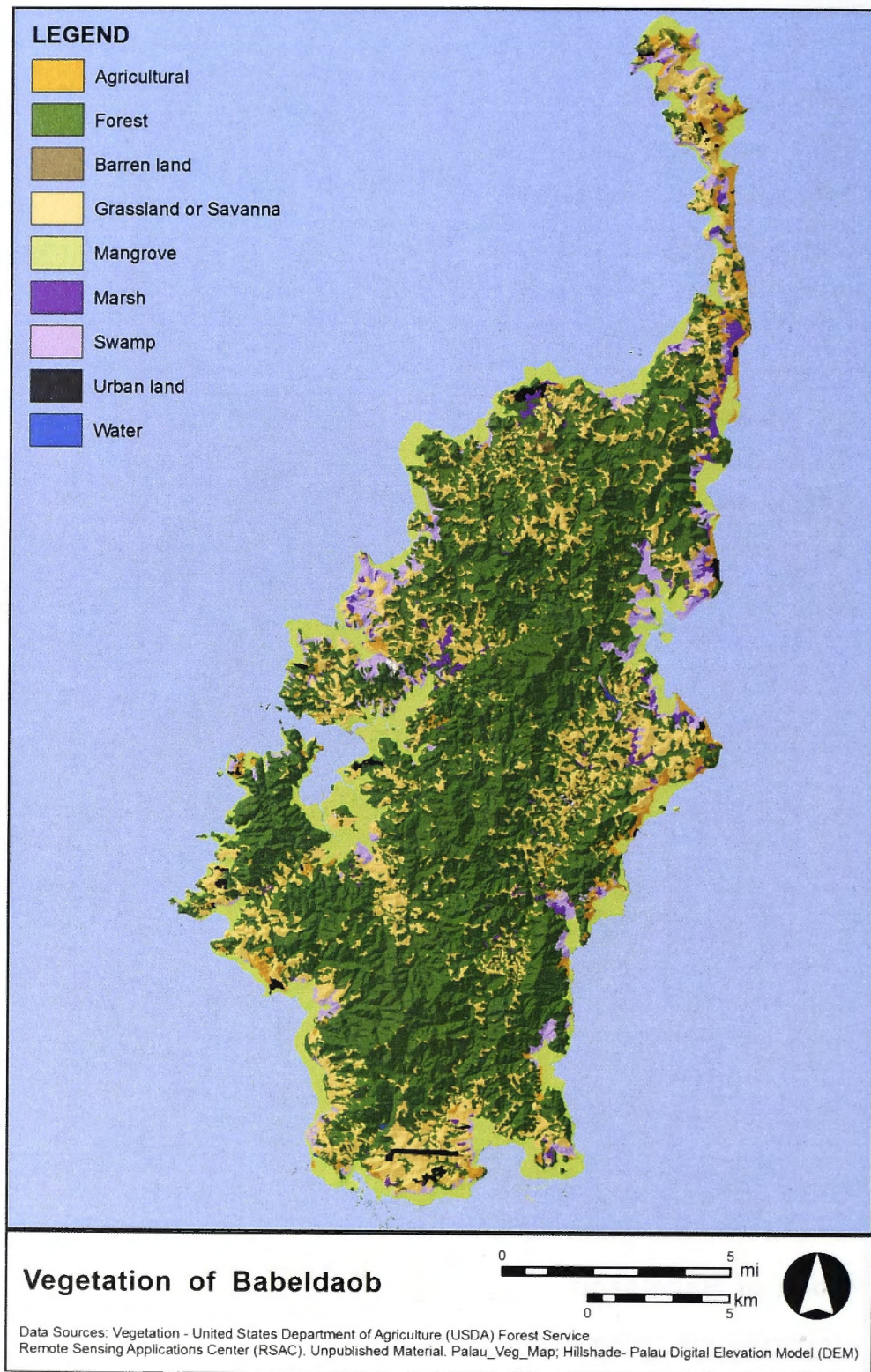


Figure 10. Current vegetation regimes on Babeldaob.



Figure 11. Wide mangrove forest below earthworks in Ngaremlengui.





Figure 12. The Ngeskebei step-terraces in Ngaremlengui.



Figure 13. High step-terraces on Ngemkeang in Ngaremlengui.



Figure 14. Basin in Uluang crown in Ngaremlengui. Photograph by Pat Colin.



Figure 15. Inside the basin on the summit of the Oratelruul crown in Ngiwal.



Figure 16. Low modified ridge backed by the high modified Ngebedech ridge capped by a paved level area. Two Type I complexes in Aimeliik.



Figure 17. Tablemeduu modified ridge (Type I) with gullies and earth platforms in Ngaraard.



Figure 18. Ngerkelalk Type IIIb complex with gullies and step-terraces capped by a crown in Aimeliik.



Figure 19. A gully containing step-terraces in Ngatpang's Type II Ngermedangeb complex.



Figure 20. Low rectangular crown with berm on one side in Airai.

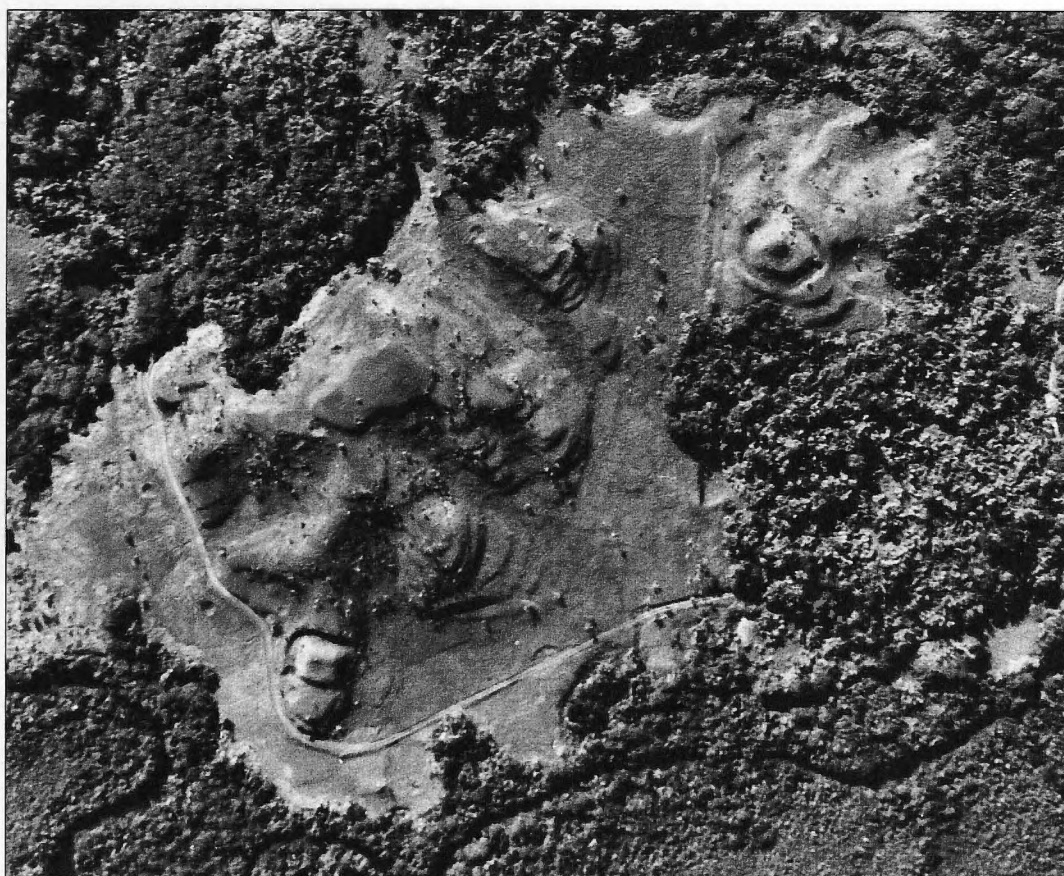


Figure 21. Two views of Ngatpang's Type II Ngermedangeb complex capped by a levelled hill. Ngermekii crown and ditch in upper right of the 1969 (6-2-53) aerial photograph.

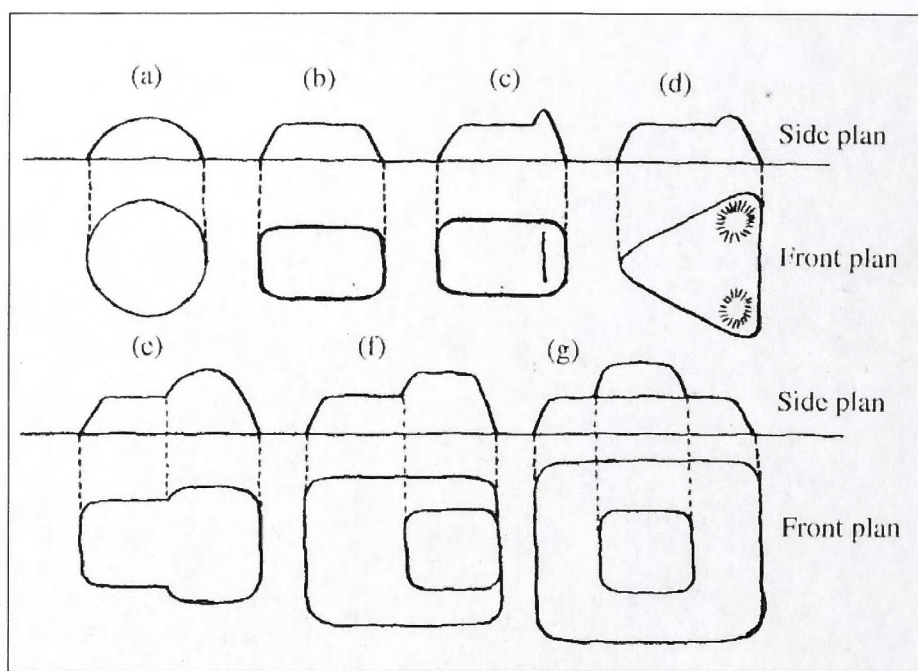


Figure 22. Crown shapes as drawn by Hijikata (1993:53, Figure 28).



Figure 23. Ngerebngai triangular crown in Ngaraard.

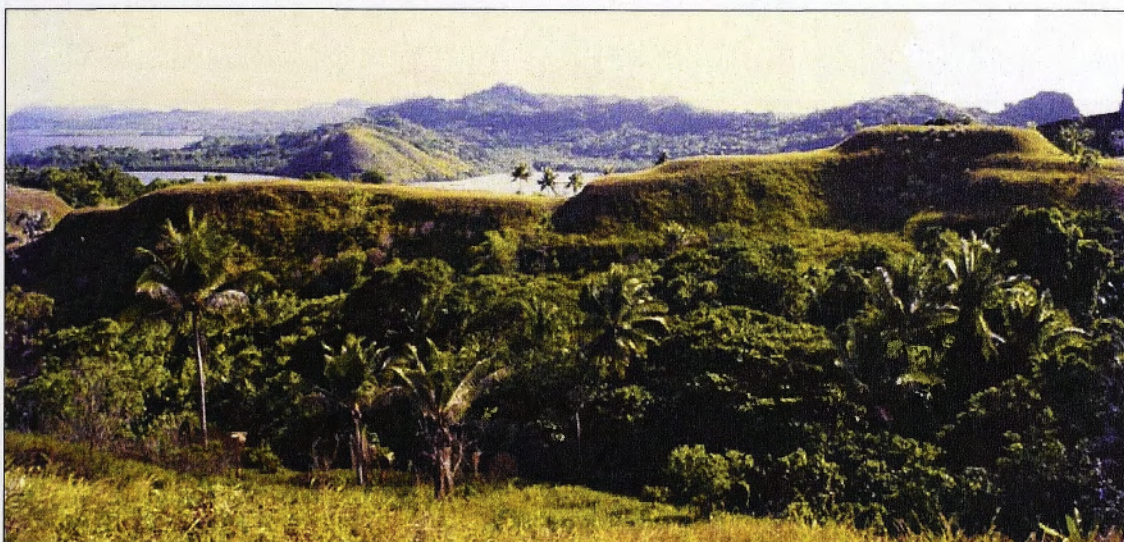


Figure 24. Low circular crown on Ongelwatel in Ngaremlengui.



Figure 25. Ngermelkii crown and ditch in Ngatpang.



Figure 26. Infilled ditch around base of crown with basin on Oratelruul crown in Ngiwal.



Figure 27. Ditch cutting ridge leading to the Ngetilai crown, a Type IIIa complex in Ngardmau.



Figure 28. Ongelwatel saddle terrace in background with Ngeskebei step-terraces in foreground, in Ngaremlengui.



Figure 29. A Type II complex in Aimeliik in 1976 (6-2) aerial photograph.



Figure 30. A Type III complex in Ngaraard.



Figure 31. Two views of Roisingang, a type Type IIIb complex in Ngaraard. Upper step-
terrace is faced in stone. Aerial photograph dates to 1976 (%-189).



Figure 32. Views of the Ngeskebei Type IV complex in Ngaremlengui.

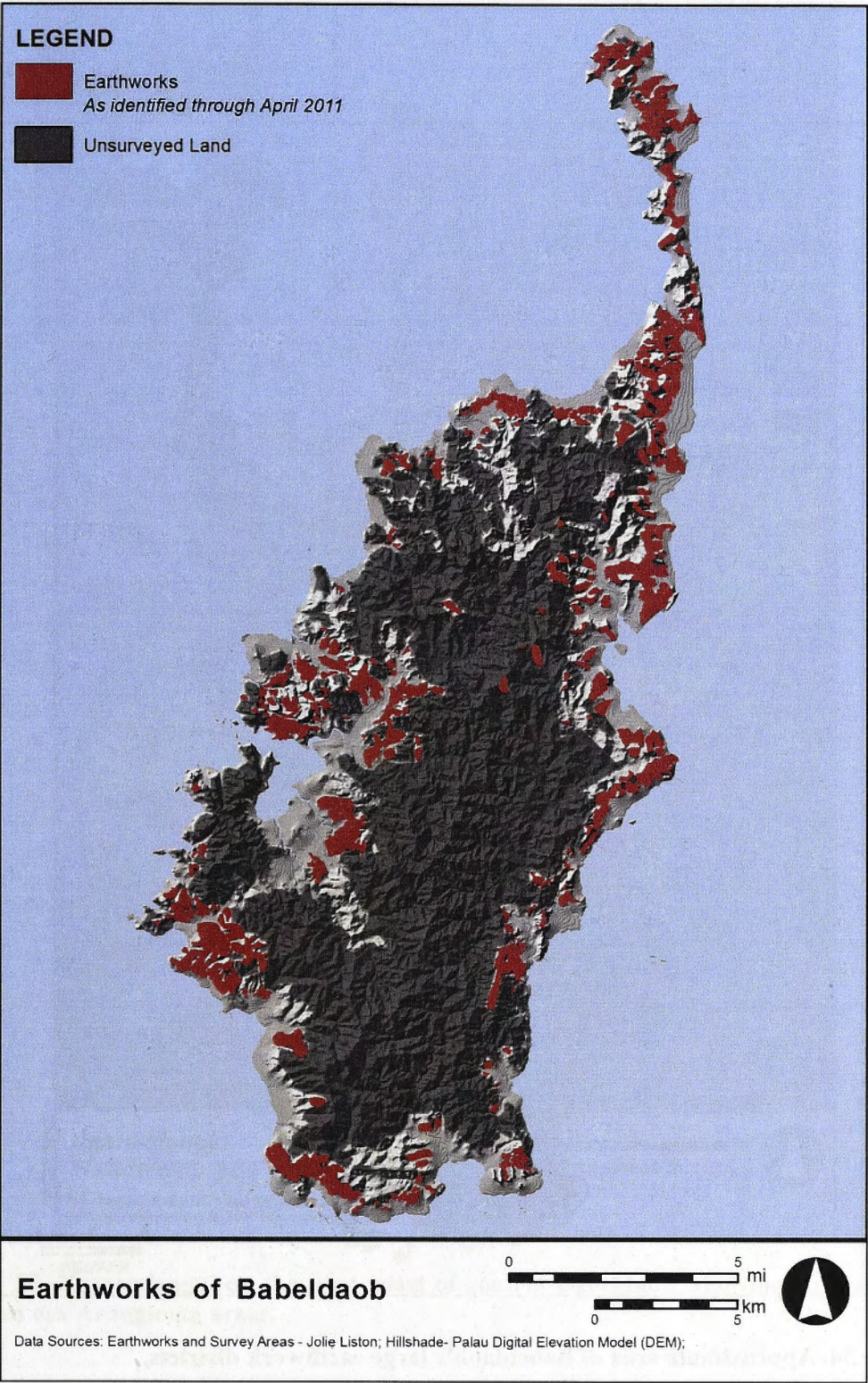


Figure 33. Location of Babeldaob’s earthworks and unsurveyed land.

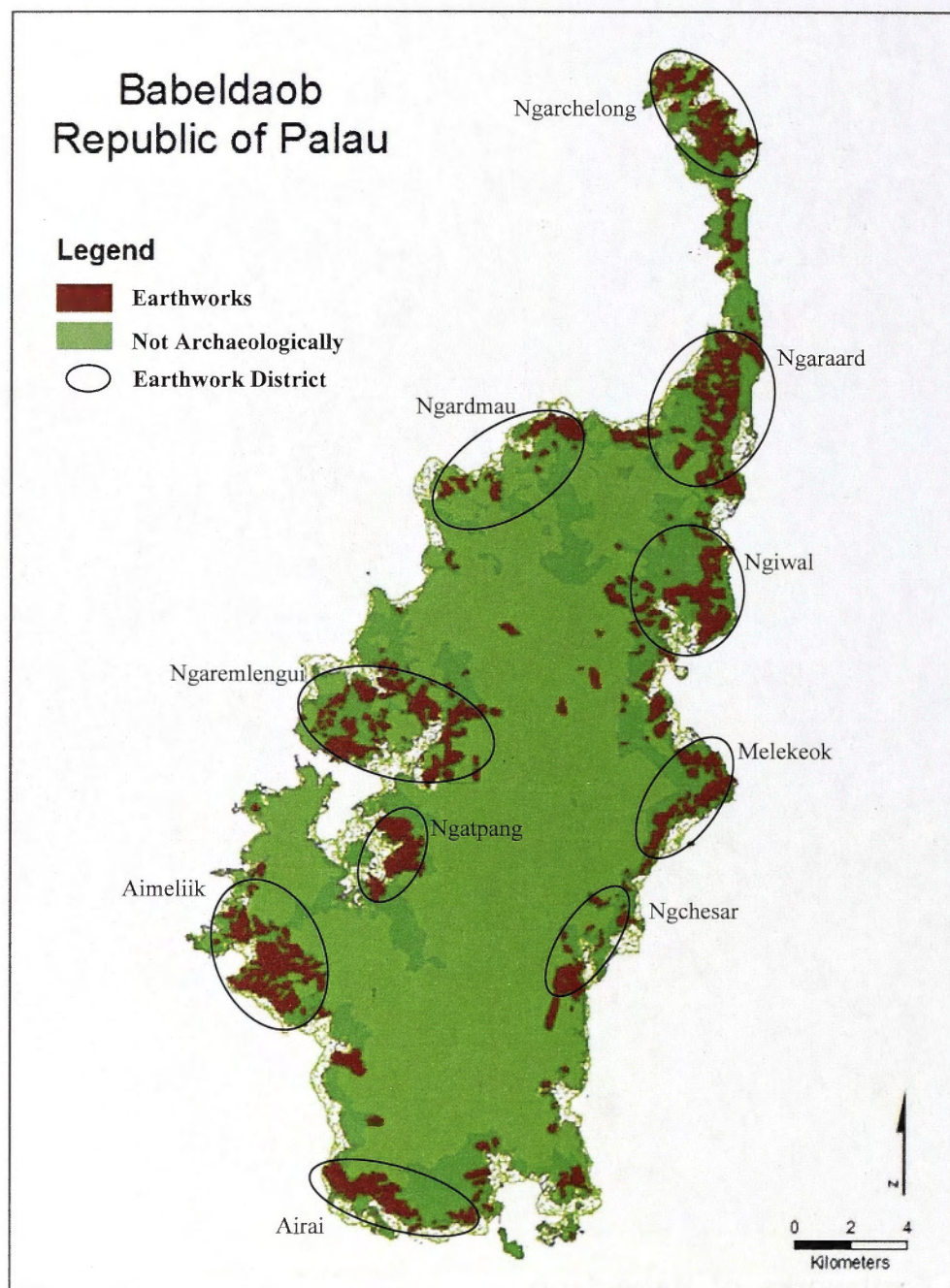


Figure 34. Approximate area of Babeldaob's large earthwork districts.

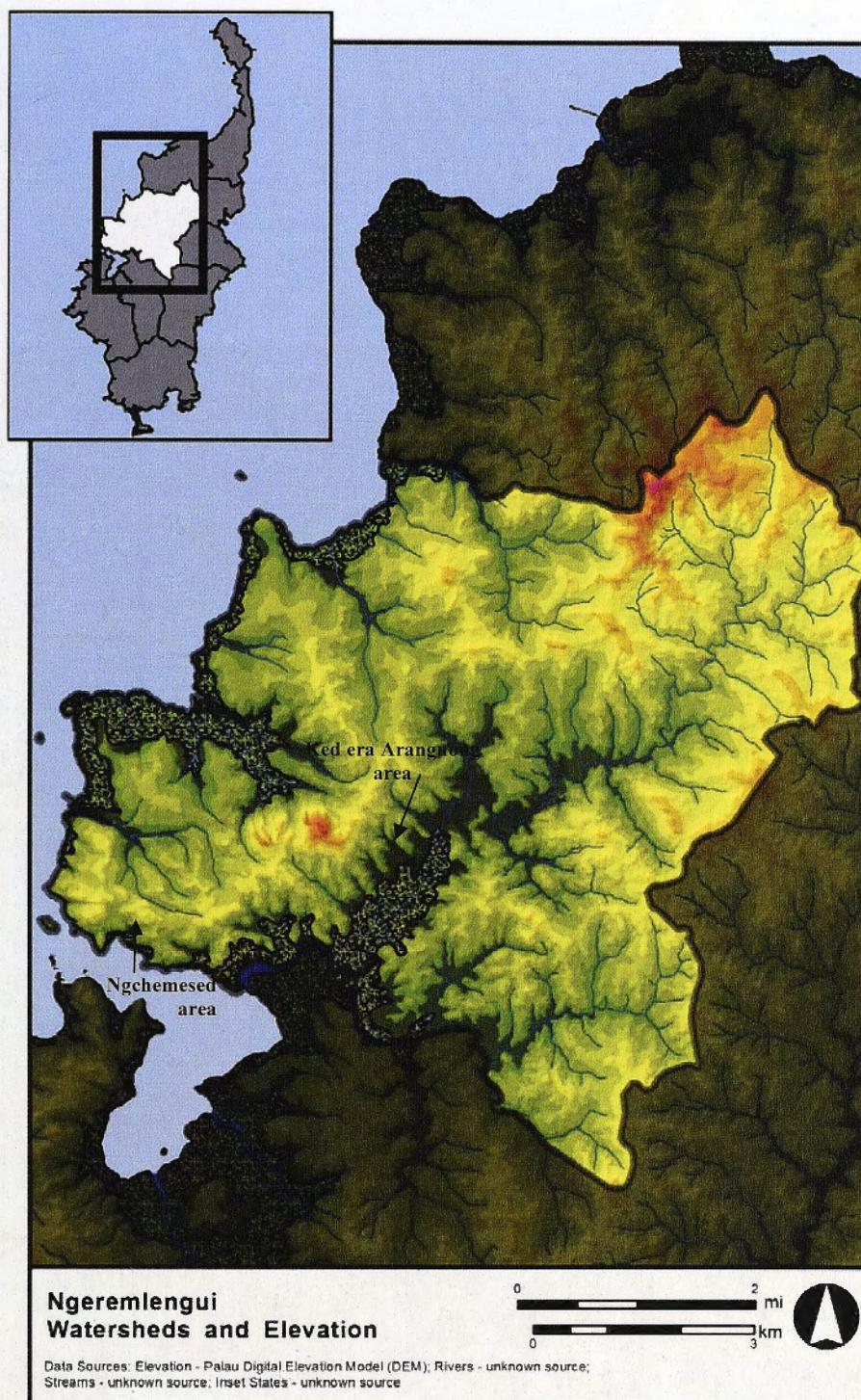


Figure 35. Ngeremlengui on the west coast of central Babeldaob, showing Ngchemesed and Ked era Aranglo areas.

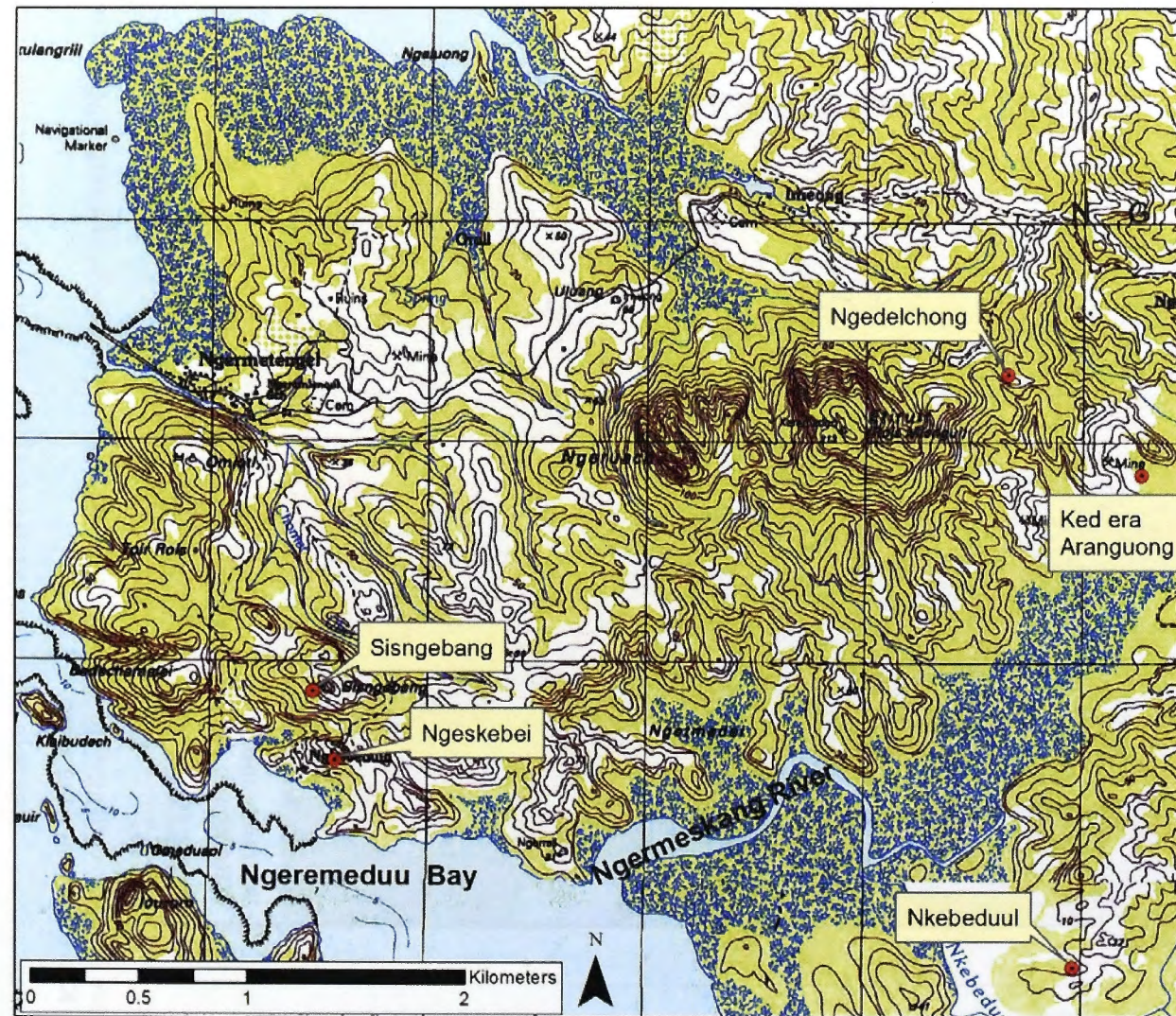


Figure 36. Topographic map of Ngaremlengui showing locations of sites investigated in thesis.

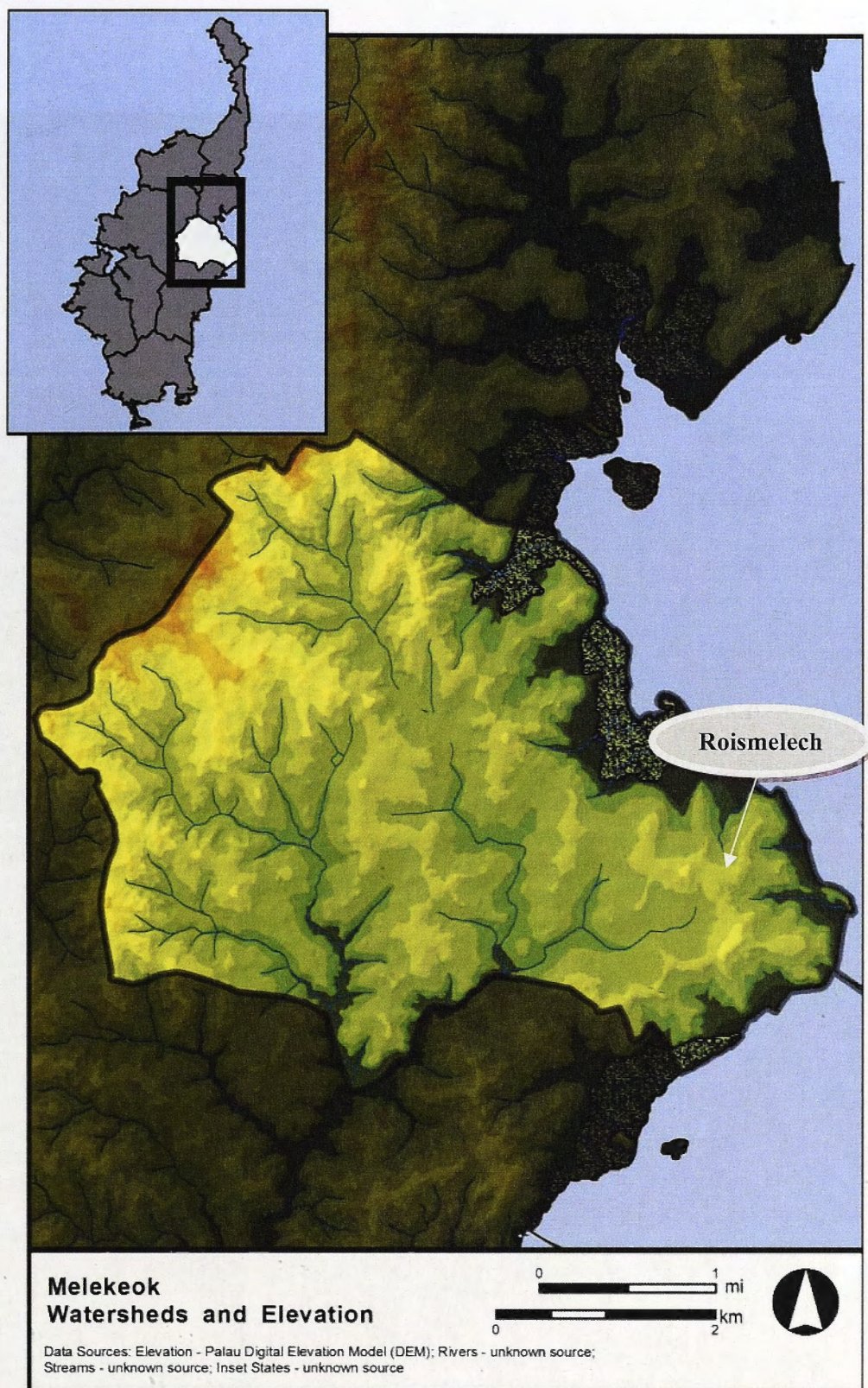


Figure 37. Location of Roismelech in Melekeok.



Figure 38. Sisngebang crown and crown outcrop overlooking entrance into Ngeremeduu Bay in Ngaremlengui.

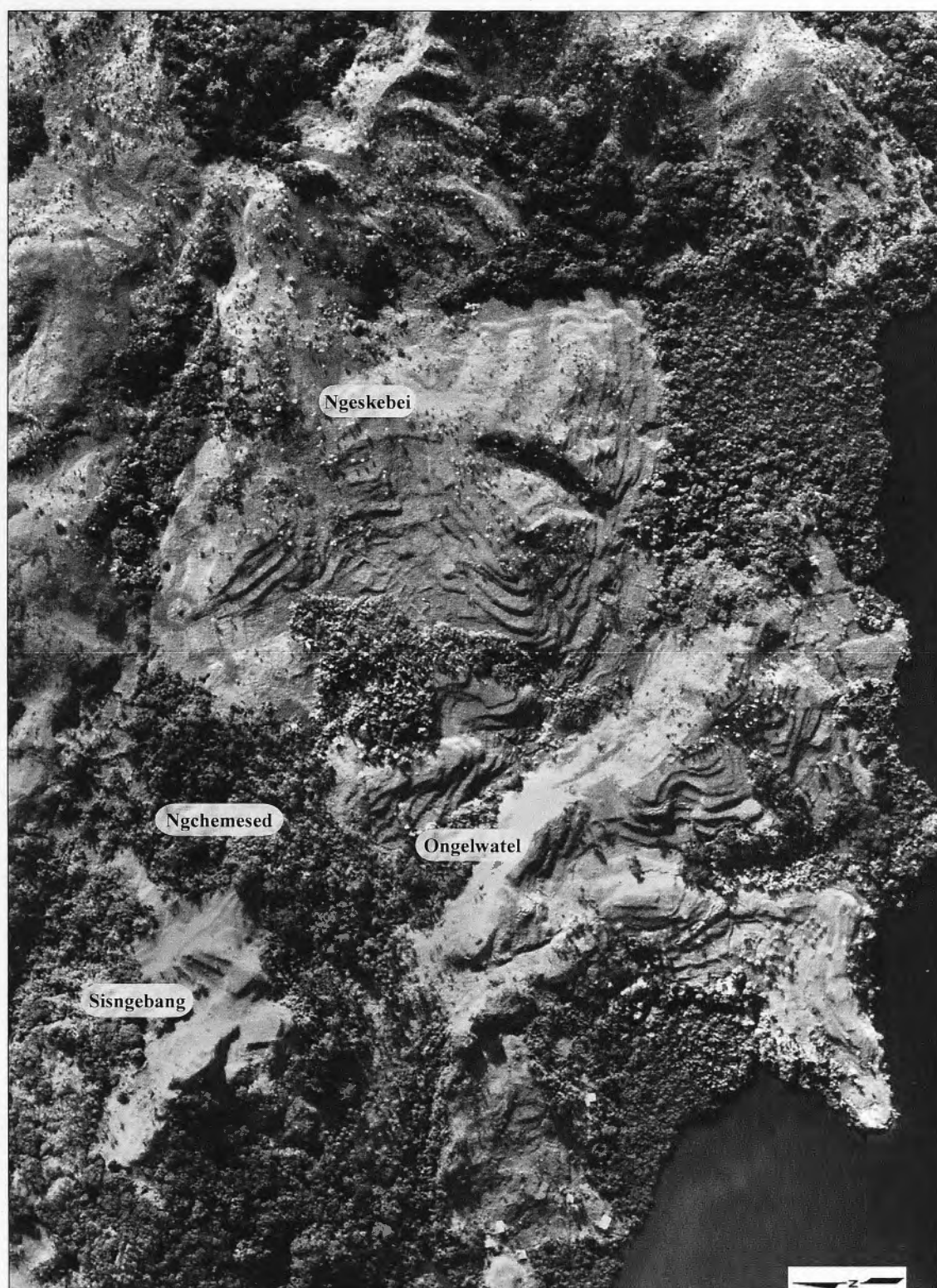


Figure 39. Earthworks in the Ngchemesed area of Ngaremlengui in a 1976 (5-20) aerial photograph.

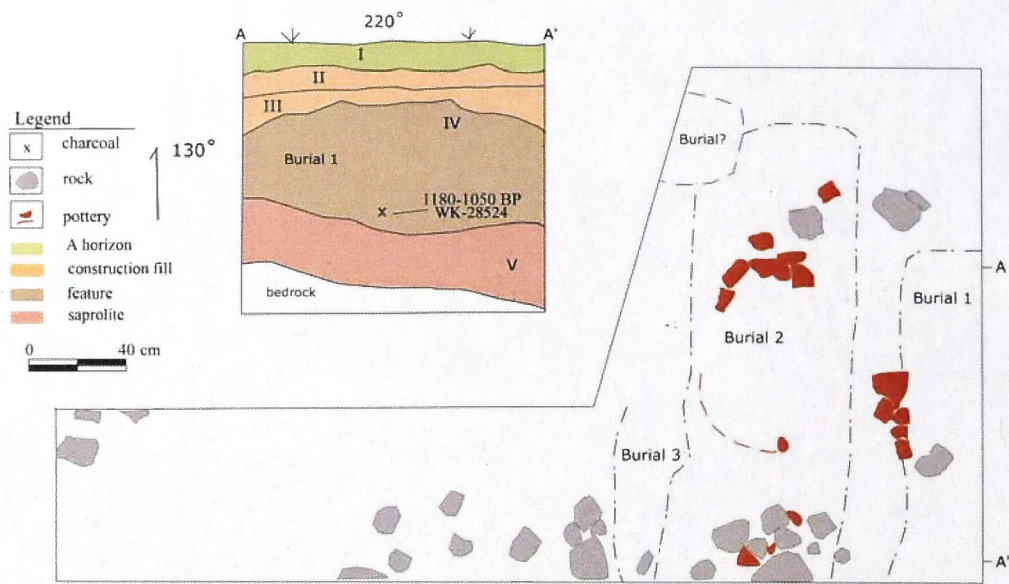


Figure 40. Sigsnebang, Trench 16, plan and profile view.



Figure 41. Sigsnebang, Trench 16, burial pits.



Figure 42. Sisngebang, Trench 16, whole pot on burial pit.



Figure 43. Reconstructed pot from burial pit on Sisngebang.

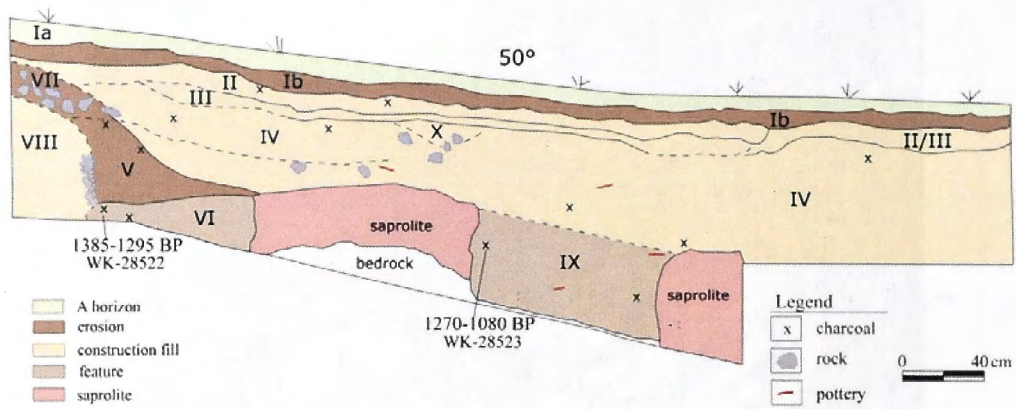


Figure 44. Sisngbang, Trench 15, profile.

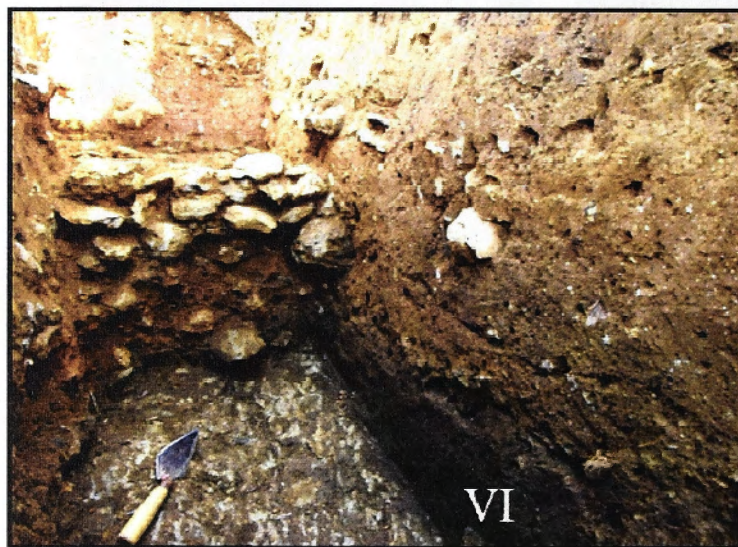


Figure 45. Sisngbang, Trench 15. Retaining wall above. East wall below.



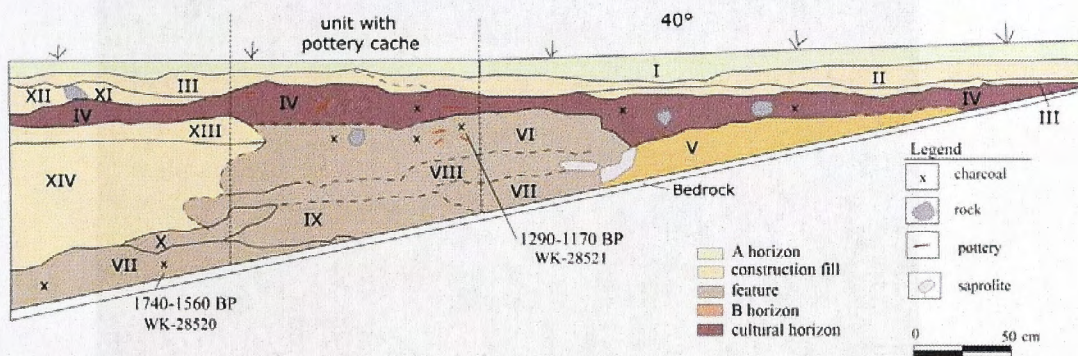


Figure 46. Sisinebang, Trench 11, east wall profile.



Figure 47. Sisinebang, Trench 11, northeast end with pit at base.

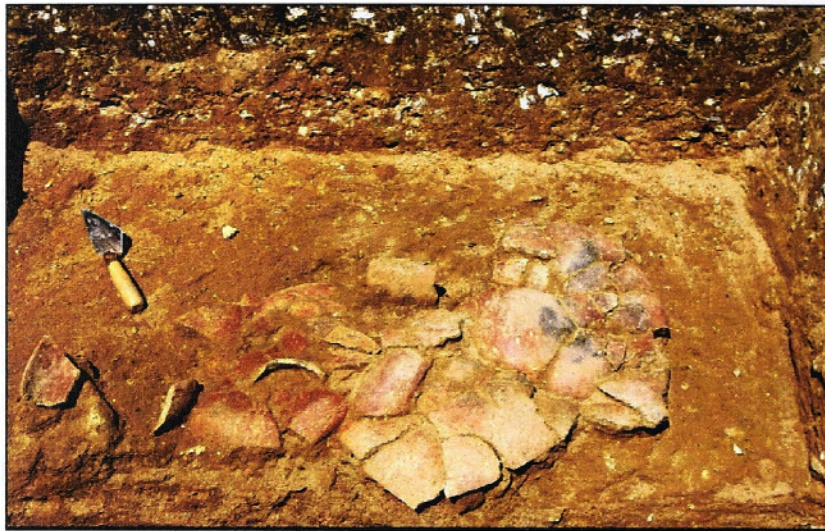


Figure 48. Sisngebang, Trench 11, pottery cache.

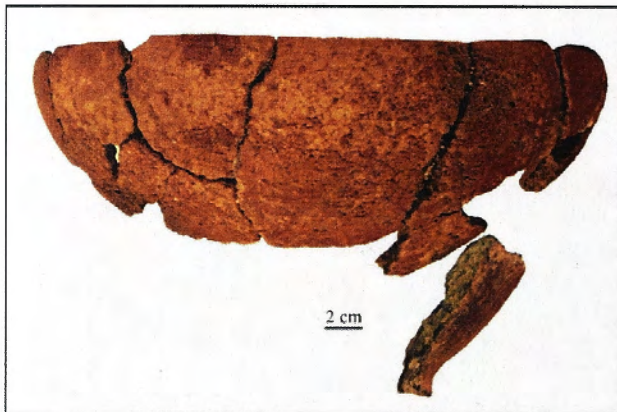


Figure 49. Pot 3 with decoration from Sisngebang pottery cache.



Figure 50. Pot 1 left, Pot 2 below from Sisngebang pottery cache.



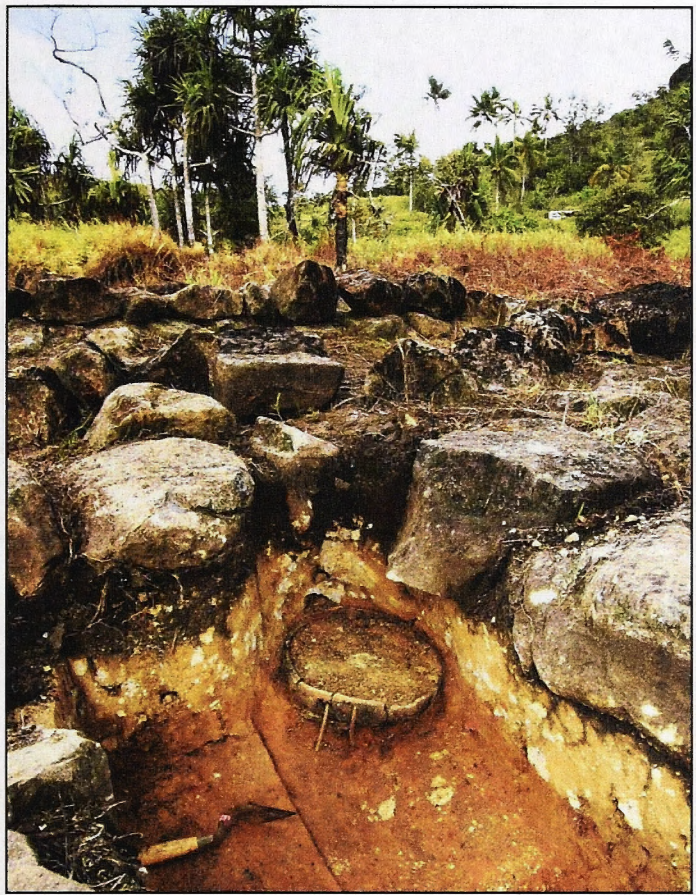


Figure 51. Ongelwatel, whole pot beneath stone paving.



Figure 52. Reconstructed pot from Ongelwatel.

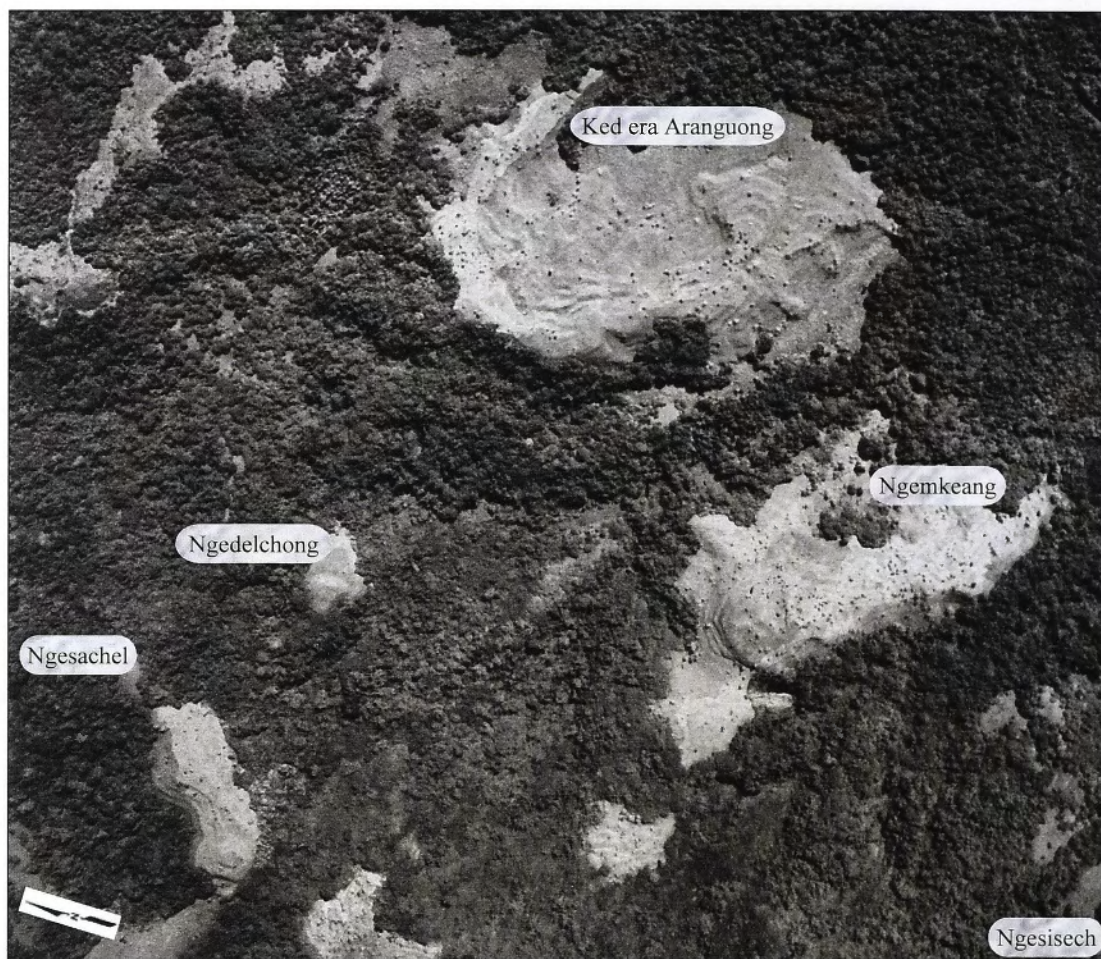


Figure 53. Aerial photograph taken in 1976 (5-280) of Ked era Aranguong area in Ngaremlengui.

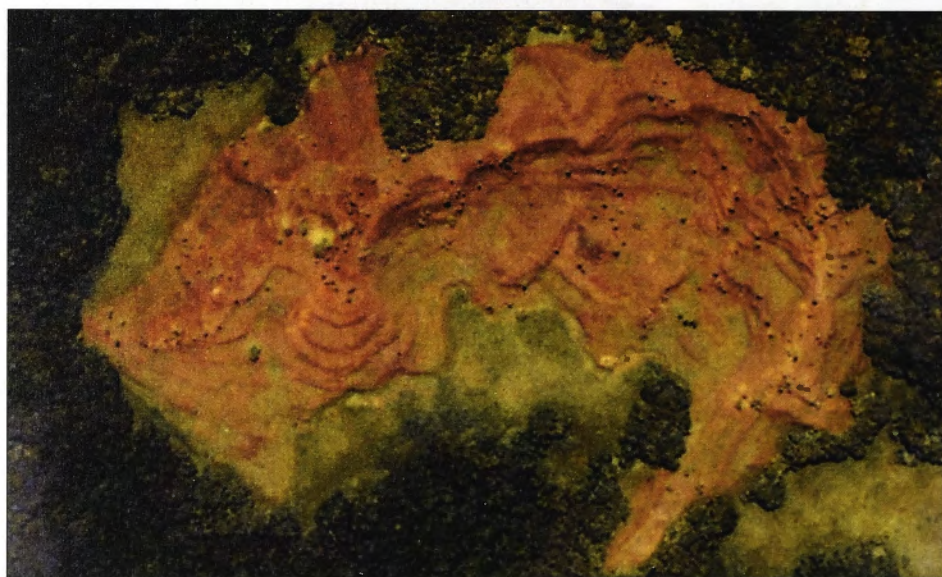


Figure 54. Ked era Aranguong in Ngaremlengui in 1992 (4-9-7,18) aerial photograph.

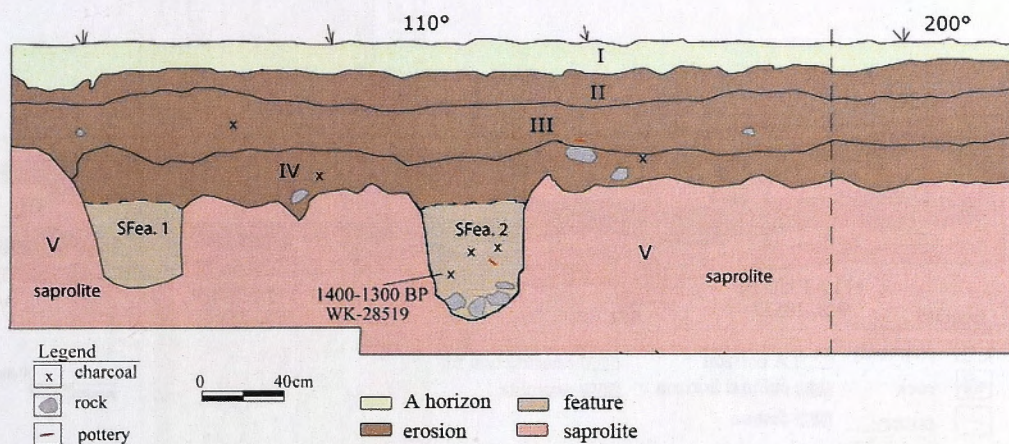


Figure 55. Ked era Aranguong, Trench 9, profile.



Figure 56. Ked era Aranguong, Trench 9, ditches in plan and profile.

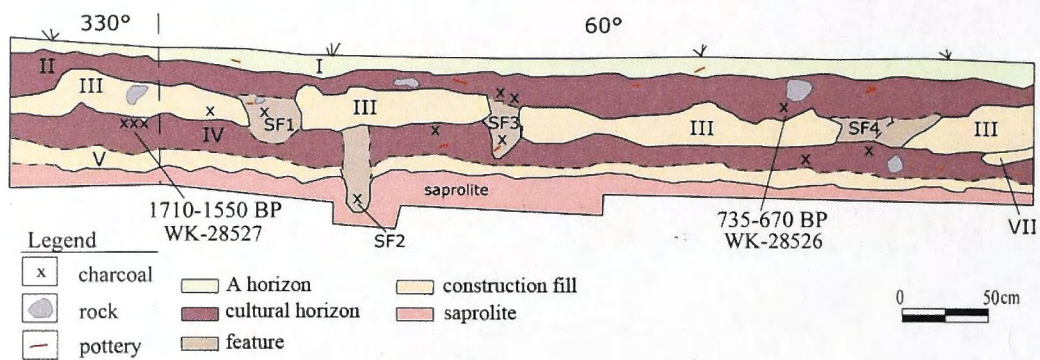


Figure 57. Ked era Aranguong, Trench 5, wall profiles.

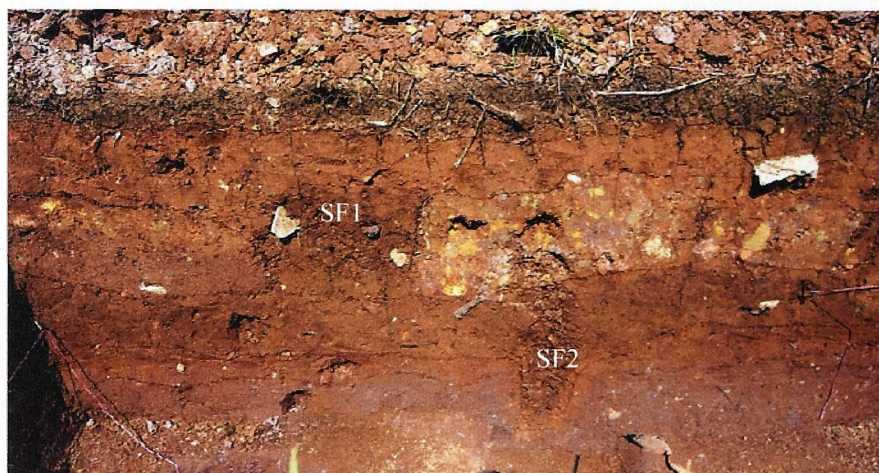


Figure 58. Ked era Aranguong, Trench 5, northeast corner wall profile.

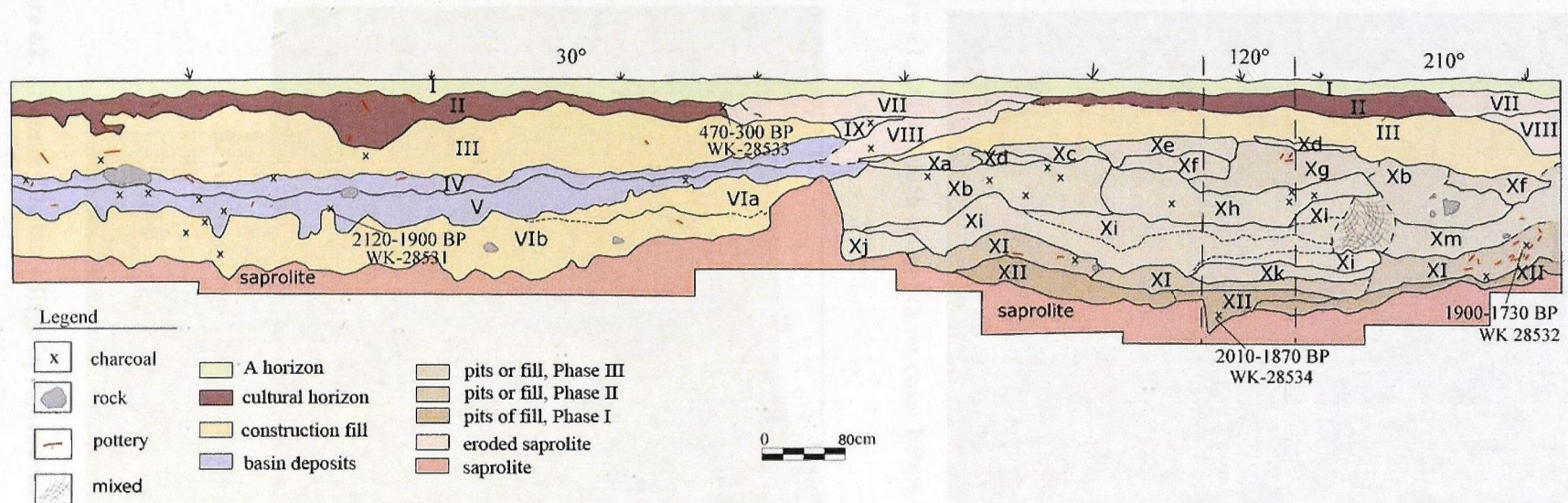


Figure 59. Ngedelchong crown profile.



Figure 60. Center and east end of Ngedelchong crown profile.



Figure 61. Odalmelech monolith on coast below Roismelech.

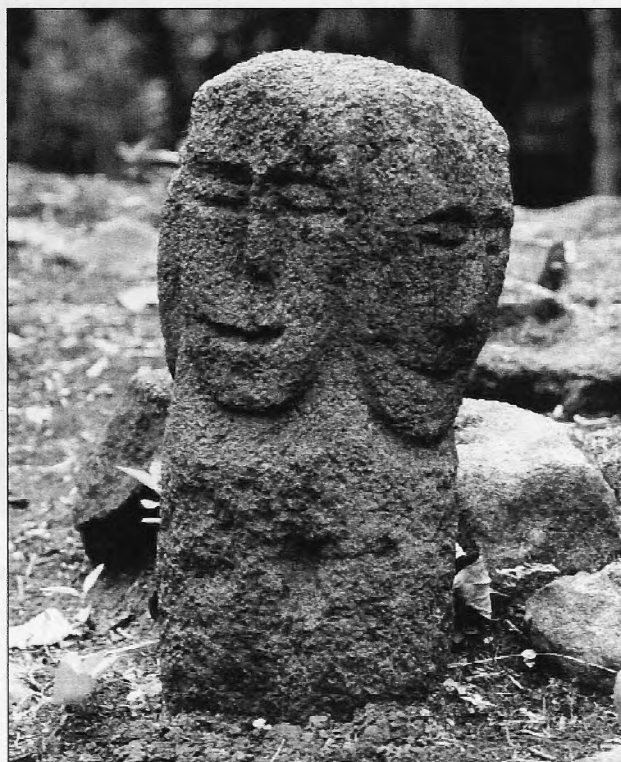


Figure 62. *Klidm* in Chelab village in Ngaraard.

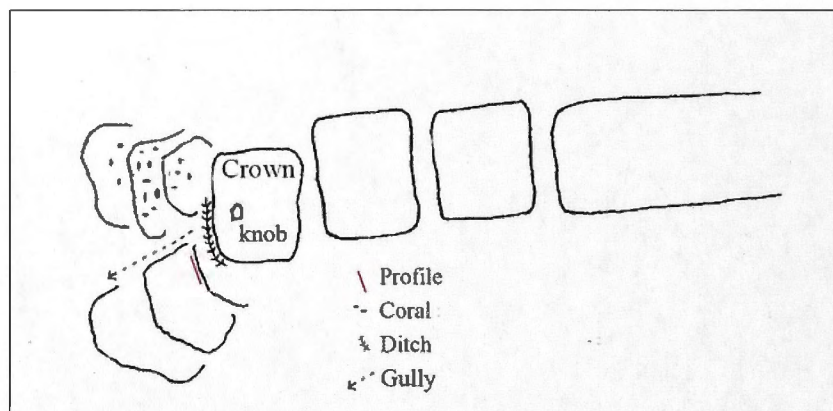


Figure 63. Schematic illustration of portion of Roismelech (adapted from Lucking 1981:125).



Figure 64. Cut terrace at Roismelech showing coral alignments with whole pots (photo by C.T. Emesiochel).

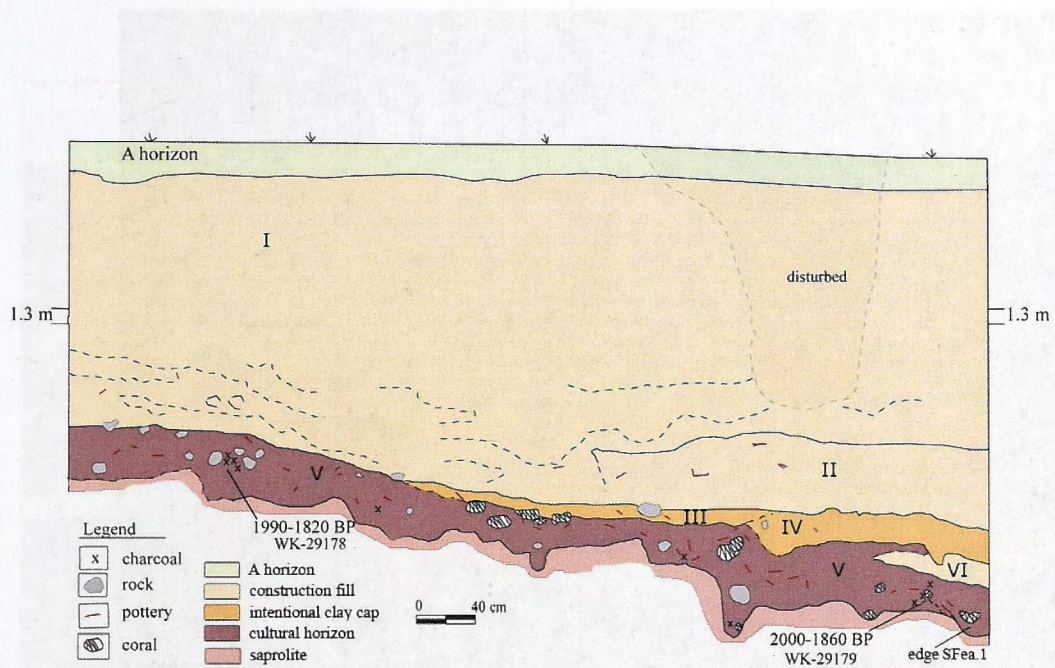


Figure 65. Rosimelech profile.



Figure 66. Central portion of Rosimelech profile.



Figure 67. Subfeature 1, whole pots on prepared surface under earthwork construction fill at Roismelech (photo by C.T. Emesiochel).



Figure 68. Reconstructed pots from Subfeature 1, Roismelech. Pot 1 to left, Pot 2 below.





Figure 69. Dryland farming in gully at base of crown complex in Ngchesar.





Figure 70. Whole pots and rock-filled pit on saprolite under earth platform on Tabelmeduu ridge.



Figure 71. Pottery cache under earth platform at Tabelmeduu ridge.

APPENDIX C. PALAUAN ARCHAEOLOGY GLOSSERY

Glossery is adapted and expanded from Tellei et al. 2005 and Suguira 1958.

<i>bad</i>	stone, rock, coral; crossbeams supporting the floor of a <i>bai</i>
<i>badritech</i>	basalt rocks
<i>bai</i>	meeting house or men's council hall; includes the building and the area surrounding the building
<i>bai era rubak</i>	meeting hall for the council of chiefs
<i>beluu</i>	village, hamlet
<i>beng</i>	fish weir; constructed by piling coral rocks in or near places on reef known for fish runs
<i>bkul</i>	corner, angle, joint
<i>blai</i>	house
<i>blebaol</i>	head trophy
<i>blil a blebaol</i>	stone container for head trophy
<i>blil a chelid</i>	a spirit house that is carved in stone
<i>bluks</i>	stone grave markers
<i>bong</i>	drainage ditch
<i>btangch</i>	standing stone, often used as a backrest for men sitting on a platform; on a <i>bai</i> platform, there would usually be four <i>btangch</i> for the title holders of the four corner clans
<i>btelul a chang</i>	beginning of a path, could be many on a single path
<i>bukl</i>	hill
<i>chades</i>	stone-paved road or pathway
<i>cheldukl</i>	general term for a stone construction
<i>cheldukl el diong</i>	stone-paved bathing place
<i>cheldukl el rael</i>	stone path
<i>chelebacheb</i>	limestone islands
<i>cheleliuis</i>	narrow causeway between taro patches, can serve as boundaries
<i>chelid</i>	demi-god
<i>chelim</i>	a ring of stones around the perimeter of a residential structure to keep water from entering the ground under the raised house floor and as a brace for the roof when it was lowered in high winds
<i>chëmrungel</i>	ground under the raised house floor, used as a storm shelter when during storms the roof lashings are cut or loosened to allow the roof to slide down, the floor is then brought down to the ground for people to sit on
<i>chereomel</i>	mixed forest, agroforest
<i>chochallechutem</i>	volcanic islands
<i>chomedoilmach, omdok uach</i>	"to catch a foot"; a ditch dug parallel to the contour, lateral ditch

<i>dechel</i>	marshy land prepared for damp or wet planting of giant taro; can also mean overgrown or untended taro patch
<i>delemeklochel</i>	swampy area in the middle of the forest
<i>deleuechel</i>	'steps cut into a coconut tree'; a shaped hill; used in late 19th century (Krämer 1917)
<i>demetaoch</i>	natural passage through mangrove too small for watercraft
<i>diangel</i>	canoe house
<i>diong</i>	well or spring, also a stone paved bathing place
<i>eual saus</i>	four corner posts
<i>euatel</i>	fortification or defensive feature
<i>Ibedul</i>	title of high chief from Koror
<i>iliud</i>	resting platform
<i>imuul</i>	wooden beam
<i>iunglel</i>	small land mounds in fresh water swamp
<i>kaud</i>	retaining wall to hold soil in sloping area
<i>kebokeb</i>	area between dry land and inner edge of mangrove forest
<i>keburs</i>	mangrove
<i>ked</i>	savannah
<i>klaidebangel</i>	"hole dug as a trap"; a ditch placed longitudinally along the main contour line; generally bisects a ridge, transverse ditch
<i>kldokbai</i>	<i>bai</i> that has walls made out of pandanus and other materials instead of carved wood
<i>kesokes</i>	fish net
<i>klemedoal</i>	dock
<i>klidm</i>	stone monolith with face
<i>kliokl</i>	dug-up area or low place that appears to have been dug up
<i>klobak</i>	Council of Chiefs
<i>klubed</i>	a landing place for an individual or a clan
<i>lalou</i>	outer edge of mangrove forest
<i>ledes</i>	small stone paved path
<i>lkul a dui</i>	taro patch for a title holder
<i>mesei</i>	wetland taro garden prepared through labour intensive work in marshy wet soil; grasses are removed by the roots and certain types of green manure is applied as fertilizer before planting
<i>ngeaol</i>	a type of garden, usually for flowers
<i>odesongel</i>	clan burial platform; has <i>bluks</i> and a house parallel to one side
<i>olad</i>	whetstone
<i>olbed</i>	stone platform that is not used for human burials – does not have <i>bluks</i>

<i>olbedel</i>	pottery lamp
<i>ongereuakl</i>	digging stick
<i>olangch</i>	symbol
<i>olengrull</i>	resting place (Lucking 1981)
<i>olechutel</i>	big, crude cargo raft made out of bamboo
<i>olengimes</i>	reef flats
<i>olkerodel</i>	landing place
<i>ollumel</i>	drinking vessel; place to get drinking water
<i>omail</i>	coconut shell container
<i>omeklochel</i>	fresh water swamp
<i>omkedecheraol blai</i>	house site
<i>omrokongol</i>	swamp planted with giant taro (<i>Cyrtosperma</i>)
<i>orsachel dub</i>	mortar and pestles
<i>oublallang el bukl</i>	stepped hills; relatively recently used Palauan term
<i>rael</i>	road, path, way, connection
<i>rael keobel</i>	sea/reef path
<i>re dimla chad</i>	first wave of immigrants to Palau
<i>rechiil</i>	sea shell
<i>rengedel</i>	hamlet
<i>rois</i>	mountain
<i>rubak</i>	male title holder
<i>sers</i>	a dryland garden
<i>taoch</i>	channel through the mangrove, artificially enhanced
<i>tekiimelab</i>	demi-gods
<i>telemtumul</i>	swidden fields
<i>telongeklel</i>	"the heights"; hilltops; used in late 19th century (Krämer 1917)
<i>toachel</i>	deep water channel or passage
<i>ulengang</i>	spirit house

APPENDIX D. TRADITIONAL SOIL CLASSIFICATION

Palauans have comparatively few words for variations in soil (Kubary 1926:257; Olsudong et al. 2008:95; V. Blaiyok, pers. communication, 2011). In traditional soil classification, colour and the distinction of “clay” are the primary attributes noted. *Chutem* means both “soil” in the broad sense and “land.” Red soil is *bekerkard el chutem*, red clay is *oriich*, yellow soil is *cheduu* and saprolite is *techel a chutem*. The black mud found in taro patches is *chutem era mesei* while mangrove mud is *ilachetomel*. Seabed is *bertakl* and sand is *chelechol*. *Chesechaem* is limestone and, in the Rock Islands, when eroded and disintegrated into smaller loose pieces it becomes *mlus*.

A single traditional narrative referring to soil classification is found in Palau’s documented oral histories. In the 1920s, Hijikata (1996:176-177) was told the story of the Rock Mother and Child which explains why certain areas have specific soil types.

There was a woman in Ngetmel by the name of Ungelelachutem. (Ungelelachutem is the name of a soft, red-colored type of stone.) Ungelelachutem gave birth to a daughter, whom she named Oriich (red clay), and then to another daughter, whom she named Cheduu (yellow soil). Following that, she gave birth to yet another daughter, whom she named Chas (a type of smooth stone), and then to still yet another daughter, whom she named Chellabed (the name of a tree). She then gave birth to a son, whom she named Merangd, as well as another son, whom she named Kederiang. Oriich married Mad in Ngerard, Chas married Erameketii [Ngirameketii] in Chol, and Chellabed married Charbedul in Ngerutoi.

Mad and his wife Oriich went to Ngetmel to hold a mur celebration. Since Oriich’s mother had no home but lived instead under a tree, Oriich ashamedly said to Mad, “What’s to be done? There’s no house where the mur celebration can be held.” Telling her not to worry, Mad went off to the bai (meeting centre) and asked Merangd to go out and catch fish for the celebration. Merangd (which means flower coral), however, unable to catch even one fish, was at loss. Mad, thereupon, taught him how to make a chehingel (large fishtrap) and had him catch fish with it. This is said to be the origin of the chehingel in Palau.

After the mur was concluded and they all returned home again, the mother (Ungelelachutem) stood on the top of a treeless hill and, beckoning to Mad and the others, said, “My many children, I wouldn’t know what to do if you were all to go off somewhere and abandon me here. Please stay here with me.” Paying her no heed, however, Mad left with his wife and went back home. Ungelelachutem’s anger brought about the deaths of all of her daughters. Even today, oriich (red soil) can be found in Imechei in large quantities. There are large quantities of cheduu (yellow soil) on the treeless hill of Mechebechab in Mengellang. There are large quantities of chas (smooth stone) on the treeless hill of Tebadeldil in Chol. There are many chellahed trees in Ngerd mau. Merangd, in despair, jumped into the sea and turned into a mud fish [damsel fish], which then dwelt inside of the body of Merangd. If you go down to the sea, even now you will probably still be able to hear the mud fish quarreling noisily out of sight inside Merangd.

APPENDIX E. EARTHWORK RADIOCARBON DATES

Sample No.^	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
Colonization/Expansion Era (>3200-2400 BP)								
WK-13974	Toietmeduu, NA-4:12, Profile 2, SFea. 1, V, (284)	erosion	<i>Cynometra ramiflora</i>	-25.9	3139 ± 52	1520-1290 BC	3470-3240	Liston 2007a
WK-28515*	Ngeskebei, NM-1:5, TR 6, SFea. Ib, 160	small pit matrix - cut into B/C horizon	unident. woody species (Unknown I)	--	3089 ± 30	1430-1260 BC	3380-3210 BP	Liston, thesis
WK-27005	Ngeskebei, NM-1:5, TR 2, SFea. 1, 135	small pit matrix - cut into C horizon	cf. <i>Maytenus palauica</i>	-27.0	2970 ± 30	1310-1050 BC	3260-3000 BP	Liston, thesis
WK-5926	Ngebars, NT-3:10, TR1, IX, (200)	construction fill	cf. <i>Macaranga carolinensis</i>	-26.6	2809 ± 72	1200-810 BC	3150-2760	Liston 2007a
WK-14077	Ngebars, NT-3:10, Profile 4, SFea. 5, II, (60)	construction fill	cf. <i>Xylocarpus granatum</i>	-26.7	2821 ± 41	1120-890 BC (93.5%), 870-850 BC (1.9%)	3070-2840 (93.5%), 2820-2800 (1.9%)	Liston 2011a
WK-13972	Ngebars, NT-3:10, Profile 4, SFea. 2, IX, (160)	possible intact occupational surface	cf. <i>Bruguiera gymnorhiza</i>	-25.0	2750 ± 43	1000-810 BC	2950-2760	Liston 2011a
WK-6468	Ngebars, NT-3:10, TR1, V, (85-90)	construction fill	1 taxon unident. woody species	-24.1	2717 ± 58	1000-790 BC	2950-2740	Liston 2007a
WK-28518	Sisngebang, NM-1:7, TR 7, IV, 62	intact cultural horizon	cf. <i>Bruguiera gymnorhiza</i>	-26.2	2588 ± 30	820-750 BC (86.2%), 690-660 BC (6.5%), 640-590 BC (2.7%)	2770-2700 BP (86.2%), 2640-2610 BP (6.5%), 2590-2540 BP (2.7%)	Liston, thesis
WK-6467	Imengel, NA-2:22, Fea. 1, TU3, III/2, (45-48)	intact occupational surface	unident. woody species (3 taxa)	-26.5	2474 ± 67	780-400 BC	2730-2350	Tuggle 2007
WK-5941	Earthworks w/ Stonework, NI-1:10, Fea. 3, TR1, IIc, (110-120)	erosion? construction fill?	1 taxon unident. woody species	-27.3	2459 ± 67	770-400 BC	2720-2350	Kaschko 2007
WK-13971	Ngebars, NT-3:10, Profile 4, SFea. 1, VI, (104)	construction fill	cf. <i>Campnosperma brevipedunculata</i>	-27.5	2450 ± 43	670-400 BC (72.7%), 760-680 BC (22.7%)	2620-2350 (72.7%), 2710-2630 (22.7%)	Liston 2011a
Earthwork Era (~2400-1100 BP)								

Sample No. [^]	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
Early Phase (2400-2150 BP)								
WK-6469	Ngebars, NT-3:10, TR1, VIII, (140-145)	construction fill	Palm sp., +1 other taxon	-26.7	2334 \pm 60	750-200 BC	2700-2150	Liston 2007a
WK-8291	Tabelmeduu, NA-4:15, Fea. 6, FAC, IV, (75)	construction fill; first phase platform construction	<i>Diospyros ferrea</i>	-27.8	2320 \pm 60	550-200 BC (91.6%), 750-650 BC (3.8%)	2500- 2150 (91.6%), 2700-2600 (3.8%)	Tuggle 2011
WK-28530	Ked era Aranguong, NM-3:16, TR 11, IX, 104	basal erosional layer in anthropogenic gully	cf. <i>Glochidium</i> sp.	-25.4	2411 \pm 30	550-390 BC (80.8%), 740-680 BC (12%), 670-640 BC (2.6%)	2500-2340 BP (80.8%), 2690-2630 BP (12%), 2620-2590 BP (2.6%)	Liston, thesis
WK-27009	Ongelwatel, NM-1:1, TR 1, V, 112	construction fill; first construction event, on cut saprolite	cf. <i>Artocarpus altilis</i>	-26.5	2377 \pm 30	540-380 BC (93.6%), 720-690 BC (1.8%)	2490-2330 BP (93.6%), 2670-2640 BP (1.8%)	Liston, thesis
WK-5929	Earthworks, NI-1:15, Fea. 10, TR1, SU6, III, (95-107)	intact occupational surface	<i>Cocos nucifera</i> nutshell	-24.0	2222 \pm 69	410-100 BC	2360-2050	Kaschko 2007
WK-13975	Earthworks w/ Stonework, NI-1:4, Profile 1, IX, (270)	construction fill	cf. <i>Casuarina equisetifolia</i>	-26.8	2247 \pm 43	400-200 BC	2350-2150	Liston 2011a
B-140186	Ngerulmud, ME-11:1, CAP-11, TU1, II/2, (80-90)	intact occupational surface, hilltop/ crown	charcoal	-25.0	2220 \pm 60	400-150 BC (93.5%), 140-110 BC (1.9%)	2350-2100 (93.5%), 2090-2060 (1.9%)	Pantaleo 2000
WK-14075	Ngebars, NT-3:10, Profile 3, SFea. 2, IIh, (334)	erosion, ditch	<i>Syzygium</i> sp.	-28.8	2202 \pm 45	390-160 BC	2340-2110	Liston 2011a
WK-13964	Ngemeduu, NA-4:11, Profile 2, SFea. 2, (199)	erosion below crown in large pit	cf. <i>Cocos nucifera</i>	-24.7	2188 \pm 43	390-150 BC (93.1%), 140-110 BC (2.3%)	2340-2100 (93.1%), 2090-2060 (2.3%)	Liston 2011a
B-96305	Ngerulmud, ME-11:1, CAP-11, Test 1, III, (70-84)	intact occupational surface, hilltop/ crown	1 taxon unident. woody species	-27.6	2180 \pm 60	390-90 BC (94.3%), 70-50 BC (1.1%)	2340-2040 (94.3%), 2020-2000 (1.1%)	Liston et al. 1998
Middle Phase (2150-1500 BP)								
Ngaraard								
WK-8292	Tabelmeduu, NA-4:15, Fea. 6, FAC, V, (90)	construction fill, earth platform construction	1 taxon unident. woody species	-27.0	2150 \pm 60	380-40 BC	2330-1990	Tuggle 2011

Sample No. [^]	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
WK-8297	Tabelmeduu, NA-4:15, Fea. 4, TR10, SFea. I, (30-50)	pit - pottery cache; associated with earth platform construction	1 taxon unident. woody species	-26.5	2140 ± 60	380-40 BC	2330-1990	Tuggle 2011
B-236596	Tabelmeduu, NA-4:15, Fea. 16, TR 4, VIII, (98)	intact occupational surface	cf. <i>Manilkara udoido</i>	-26.5	2160 ± 40	370-90 BC	2320-2040	Liston 2008
WK-5939	Earthworks w/ Stonework, NA-1i, SU1, II, (80-95)	erosion	cf. mangrove species	-25.0	2091 ± 68	260 BC-AD 60 (84.9%), 360-280 BC (10.5%)	2210-1890 (84.9%), 2310-2230 (10.5%)	Kaschko 2007
WK-8290	Tabelmeduu, NA-4:15, Fea. 6, FAC, II, (80)	construction fill; fourth phase earth platform construction	cf. <i>Bruguiera gymnorhiza</i>	-25.3	2080 ± 60	210 BC-AD 60 (89.5%), 360-290 BC (5.9%)	2160-1890 (89.5%), 2310-2240 (5.9%)	Tuggle 2011
WK-8283	Tabelmeduu, NA-4:15, Fea. 1, TR1d, II, (21)	construction fill; second phase earth platform construction	cf. <i>Xylocarpus granatum</i>	-27.0	2070 ± 60	210 BC-AD 70 (91.7%), 350-300 BC (3.7%)	2160-1880 (91.7%), 2300-2250(3.7%)	Tuggle 2011
WK-5906	Imengel, NA-2:22, Fea. 1; TU3, III/1, (35-45)	intact occupational surface	<i>Cocos nucifera</i> nutshell	-25.4	2060 ± 66	210 BC-AD 80 (91.2%), 360-290 BC (4.2%)	2160-1870 (91.2%), 2310-2240 (4.2%)	Tuggle 2007
WK-13960	Earthworks w/ Stonework, NA-1c, Fea. 7a, TR2, II, (46)	construction fill, hilltop /crown	cf. gourd	-25.7	2056 ± 44	200 BC-AD 50	2150-1900	Liston 2011a
WK-14145	Earthworks w/ Stonework, NA-4b, Profile 1, SFea. 2, (60)	structural support post	<i>Rhizophora</i> sp.	-25.9	2057 ± 42	190 BC-AD 30 (94.4%), AD 40-50 (1.0%)	2140-1920 (94.4%), 1910-1900 (1.0%)	Liston 2011a
ANU-11687	Ngemeduu, NA-4:11, TR1a, VIII	construction fill, hilltop /crown	charcoal	-26.2	2030 ± 30	120 BC-AD 60 (92.4%), 160-130 BC (3.0%)	2070-1890 (92.4%), 2110-2080 (3.0%)	Phear 2007
WK-5920	Rois terraces, NA-4:6, TR NW, SFea. Y, (45-55)	pit – probable burial	cf. <i>Casuarina litorea</i>	-27.0	2015 ± 68	200 BC-AD 130	2150-1820	Tuggle 2007
WK-13965	Ngemeduu, NA-4:11, Profile 2, SFea. 2, (150)	erosion in large pit	cf. <i>Bruguiera gymnorhiza</i>	-24.2	2025 ± 51	180 BC-AD 80	2130-1870	Liston 2011a
WK-8281	Toietmeduu, NA-4:12, Fea. 3, TR1b, III, (60)	construction fill; first phase earth platform construction	cf. <i>Pterocarpus indicus</i>	-24.0	2010 ± 60	180 BC-AD 130	2130-1820	Tuggle 2011

Sample No.^	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
WK-8285	Tabelmeduu, NA-4:15, Fea. 1, TR1a, II, (15-20)	construction fill; second phase earth platform construction	<i>Diospyros ferrea</i>	-26.7	1980 ± 70	180 BC-AD 180 (94.2%), AD 190-210 (1.2%)	2130-1770 (94.2%), 1760-1740 (1.2%)	Tuggle 2011
WK-8282	Tabelmeduu, NA-4:15, Fea. 1, FAC1, III/H2, (45)	construction fill; first phase earth platform construction	cf. <i>Cocos nucifera</i>	-25.0	2000 ± 60	170 BC-AD 130	2120-1820	Tuggle 2011
WK-8288	Tabelmeduu, NA-4:15, Fea. 4, TR10, SFea. E, (35)	possible hearth associated with platform construction	cf. <i>Cocos nucifera</i>	-25.3	1970 ± 60	120 BC-AD 140 (92.1%), 170-130 BC (2.2%), AD 150-170 (1.1%)	2070-1810 (92.1%), 2120-2080 (2.2%), 1800-1780 (1.1%)	Tuggle 2011
WK-8286	Tabelmeduu, NA-4:15, Fea. 4, TR4, II/2, (41)	construction fill; platform construction	cf. <i>Xylocarpus granatum</i>	-25.8	1960 ± 60	110 BC-AD 220	2060-1730	Tuggle 2011
WK-8280	Toietmeduu, NA-4:12, Fea. 3, TR1e, III, (38)	construction fill; first phase, earth platform construction	cf. <i>Canarium hirsutum</i>	-26.2	1960 ± 60	110 BC-AD 220	2060-1730	Tuggle 2011
WK-13966	Mesesuiuil, NA-4a, Profile 2, SFea. 2, (62)	pit – postmold likely	cf. <i>Intsia bijuga</i>	-24.9	1981 ± 43	60 BC-AD 130 (93.2%), 90-70 BC (2.2%)	2010-1820 (93.2%), 2040-2020 (2.2%)	Liston 2011a
WK-8279	Toietmeduu, NA-4:12, Fea. 3, TR1b, III, (60)	construction fill; second phase earth platform construction	<i>Pandanus</i> sp.	-25.3	1940 ± 60	60 BC-AD 230	2010-1720	Tuggle 2011
WK-8289	Tabelmeduu, NA-4:15, Fea. 6, Facing, II, (70)	construction fill, fourth/last phase earth platform construction	cf. <i>Pterocarpus indicus</i>	-24.7	1940 ± 60	60 BC-AD 230	2010-1720	Tuggle 2011
B-241468	Tabelmeduu, NA-4:15, Fea. 16, TR4, SFea. 9, (142)	postmold	cf. <i>Cocos nucifera</i>	-24.3	1960 ± 40	50 BC-AD 130	2000-1820	Liston 2008
WK-14073	Ngemeduu, NA-4:11, Profile 1, II, (190)	erosion in large pit	<i>Buchanania</i> sp.	-26.7	1931 ± 48	50 BC-AD 180 (92.6%), AD 190-220 (2.8%)	2000-1770 (92.6%), 1760-1730 (2.8%)	Liston 2011a
WK-13970	Mesesuiuil, NA-4a, Fea. 3, TR5, IVb, (54)	garbage pit	cf. <i>Cynometra ramiflora</i>	-25.3	1920 ± 41	AD 1-220	1950-1730	Liston 2011a
WK-13967	Toietmeduu, NA-4:12,	intact occupational	<i>Hibiscus tiliaceus</i>	-25.3	1919 ± 45	20 BC-AD 220	1970-1730	Liston

Sample No.^	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
	Fea. 8, TR1, VII b, (82)	surface						2011a
WK-8287	Tabelmeduu, NA-4:15, Fea. 4, TR4, II/2, (23)	construction fill; platform construction	cf. <i>Xylocarpus granatum</i>	-26.0	1860 ± 60	AD 20-270 (90.7%), AD 280-330 (4.7%)	1930-1680 (90.7%), 1670-1620 (4.7%)	Tuggle 2011
WK-14069	Toietmeduu, NA-4:12, Fea. 8, TR1a, RV10, (63)	pot cache – 1 vessel	1 taxon unident. woody species	-27.1	1884 ± 39	AD 50-240	1900-1710	Liston 2011a
WK-13973	Earthworks w/ Stonework, NA-1c, TR4, IV, (45)	construction fill, hilltop /crown	cf. <i>Cocos nucifera</i>	-25.4	1868 ± 41	AD 50-240	1900-1710	Liston 2011a
WK-13963	Toietmeduu, NA-4:12, Fea. 8, TR2, SFea. 3, (75)	pit	cf. <i>Artocarpus</i> sp.	-24.9	1861 ± 50	AD 20-260 (93.3%), AD 300-320 (1.1%), AD 20-40 (1.0%)	1900-1690 (93.3%), 1650-1630 (1.1%), 1930-1910 (1.0%)	Liston 2011a
WK-14078	Tabelmeduu, NA-4:15, Profile 4, Pit B, (122)	pit with whole pot	1 taxon unident. woody species	-26.7	1861 ± 44	AD 50-250	1900-1700	Liston 2011a
WK-14072	Toietmeduu, NA-4:12, Fea. 8, TR1, II, (40)	construction fill	cf. <i>Syzygium</i> sp.	-25.7	1851 ± 45	AD 60-260 (94.4%), AD 300-320 (1.0%)	1890-1690 (94.4%), 1650-1630 (1.0%)	Liston 2011a
WK-14060	Toietmeduu, NA-4:12, Fea. 8, TU1, II, (13)	burn event	cf. <i>Bruguiera gymnorhiza</i>	-24.8	1821 ± 38	AD 90-260 (90.5%), AD 290-330 (4.9%)	1870-1690 (90.5%), 1660-1620 (4.9%)	Liston 2011a
WK-14071	Mesesuiuil, NA-4a, Fea. 3, SFea. 3, II, (66)	structural support post	charred plant tissue	-28.1	1811 ± 39	AD 120-340 (93.1%), AD 80-110 (2.3%)	1830-1610 (93.1%), 1870-1840 (2.3%)	Liston 2011a
WK-14082	Toietmeduu, NA-4:12, Fea. 1, TR1, SFea. 5, VII, (82)	structural support post	<i>Rhizophora</i> sp.	-25.8	1792 ± 38	AD 120-340	1830-1610	Liston 2011a
B-100018	Ngetcherong village, NA-4:4, Fea. 73, TP1, I/7, (58-69)	construction fill, hilltop /crown	<i>Rhizophora</i> sp., + 3 other taxa	-26.0	1780 ± 70	AD 80-410	1870-1540	Addison 2005
WK-5922	Rois terraces, NA-4:6, TUW, III/1, (35)	clay cap	cf. <i>Rhizophora</i> sp.	-26.6	1772 ± 67	AD 120-420 (93.3%), AD 80-110 (2.1%)	1830-1530 (93.3%), 1870-1840 (2.1%)	Tuggle 2007
WK-14081	Toietmeduu, NA-4:12, Fea. 1, TR1, SFea. 5, V, (68)	structural support post	1 taxon unident. woody species	-26.6	1745 ± 43	AD 130-410	1820-1540	Liston 2011a
WK-14070	Toietmeduu, NA-4:12, Fea. 8, TR2, III, (22)	construction fill? intact occupational surface?	1 taxon unident. woody species	-27.2	1727 ± 44	AD 210-420	1740-1530	Liston 2011a

Sample No. [^]	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
WK-5889	Rois terraces, NA-4:6, TR2; SFea. 5, (247 bd)	pit - burial	Poaceae/Grass	-24	1723 ± 68	AD 120-440 (93.2%), AD 480-530 (2.2%)	1830-1510 (93.2%), 1470-1420 (2.2%)	Tuggle 2007
WK-14147	Toietmeduu, NA-4:12, Fea. 1, TR2, SFea. 12, (40)	pit - postmold?	<i>Hibiscus tiliaceus</i>	-25.6	1709 ± 39	AD 240-420	1710-1530	Liston 2011a
WK-6463	Rois terraces, NA-4:6, TR2, SFea.2, (137-172)	pit - burial	1 taxon unident. woody species	-27.2	1695 ± 56	AD 210-470 (90.8%), AD 480-540 (4.6%)	1740-1480 (90.8%), 1470-1410 (4.6%)	Tuggle 1998
WK-5917	Isakos, NA-3:1, TU1c, VI, (118-133)	intact occupational surface, hilltop /crown	Palm sp.	-26.4	1678 ± 66	AD 210-550	1740-1400	Tuggle 2007
Ngiwal								
WK-14019	Ridgeline village, NI-1:4, Fea. 6, TR4, III, (20)	burn lens over pit with pot	cf. <i>Intsia bijuga</i>	-26.8	2111 ± 45	230 BC-AD 1 (86.1%), 360-290 BC (9.3%)	2180-1950 (86.1%), 2310-2240 (9.3%)	Liston 2011
WK-5928	Earthworks / Japanese Defensive Features, NI-1:15, Fea. 10, TR1, SU1, I, (25-40)	intact occupational surface	<i>Cocos nucifera</i> nutshell	-24.2	2053 ± 70	210 BC-AD 90 (91.2%), 360-290 BC (4.2%)	2160-1860 (91.2%), 2310-2240 (4.2%)	Kaschko 2007
WK-14063	Ridgeline village, NI-1:4, Fea. 6, TR1a, Vb, (35)	intact occupational surface	1 taxon unident. woody species	-27.4	2017 ± 39	120 BC-AD 70 (92.4%), 160-130 BC (3.0%)	2070-1880 (92.4%), 2110-2080 (3.0%)	Liston 2011
WK-14029	Ridgeline village, NI-2a, Fea. 4, TR5, SFea. 6, (60)	structural support post	cf. <i>Diospyros ferrea</i>	-30.6	2012 ± 39	120 BC-AD 80 (93.6%), 160-130 BC (1.8%)	2070-1870 (93.6%), 2110-2080 (1.8%)	Liston 2011
WK-14025	Ridgeline village, NI-2a, Fea. 4, TR5, XV, (28)	intact occupational surface	cf. <i>Intsia bijuga</i>	-25.1	2005 ± 42	120 BC-AD 80 (93.5%), 160-130 BC (1.9%)	2070-1870 (93.5%), 2110-2080 (1.9%)	Liston 2011
WK-14083	Ridgeline village, NI-1:4, Fea. 5, TR8, pit, IV, (85)	garbage pit	1 taxon unident. woody species	-25.0	1993 ± 44	110 BC-AD 90 (93.2%), AD 100-130 (2.2%)	2060-1860 (93.2%), 1850-1820 (2.2%)	Liston 2011a
WK-14027	Ridgeline village, NI-2a, Fea. 5, TR2, XXIX, (108)	intact occupational surface	cf. <i>Diospyros ferrea</i>	-28.1	1977 ± 46	100 BC-AD 130	2050-1820	Liston 2011a
WK-14065	Ridgeline village, NI-2a,	probable hearth	cf. <i>Diospyros ferrea</i>	-30.2	1979 ± 39	60 BC-AD 130	2010-1820	Liston

Sample No.^	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
	Fea. 7, TR8, SFea. 1, (40)							2011a
WK-14028	Ridgeline village, NI-2a, Fea. 4, TR5, SFea. 10, (80)	structural support post	cf. <i>Intsia bijuga</i>	-25.5	1983 ± 32	50 BC-AD 90	2000-1860	Liston 2011a
WK-14024	Ridgeline village, NI-2a, Fea. 5, TR2, III, (40)	intact occupational surface	cf. <i>Calophyllum inophyllum</i>	-25.9	1972 ± 40	50 BC-AD 130	2000-1820	Liston 2011a
WK-14026	Ridgeline village, NI-2a, Fea. 3, TR6, VIII, (52)	intact occupational surface	<i>Cocos nucifera</i>	-24.9	1933 ± 40	50 BC-AD 140 (94.4%), AD 190-210 (1.0%)	2000-1810 (94.4%), 1760-1740 (1.0%)	Liston 2011a
WK-14022	Ridgeline village, NI-2a, Fea. 3, TR6, Vib, (74)	pit	Palm species	-27.3	1921 ± 44	40 BC-AD 220	1990-1730	Liston 2011a
WK-14062	Ridgeline village, NI-1:4; Fea. 6, TR1, SFea. 1, (37)	partially rock-lined pit	<i>Buchanania</i> sp.	-27.2	1894 ± 41	AD 20-230	1930-1720	Liston 2011a
WK-14023	Ridgeline village, NI-2a, Fea. 2, TR9, IV, (40)	intact occupational surface	Palm species	-24.8	1867 ± 41	AD 50-240	1900-1710	Liston 2011a
WK-14064	Ridgeline village, NI-2a, Fea. 3, TR12, III, (98)	intact occupational surface	1 taxon unident. woody species	-30.6	1825 ± 39	AD 80-260 (91.2%), AD 290-330 (4.2%)	1870-1690 (91.2%), 1660-1620 (4.2%)	Liston 2011a
WK-14020	Ridgeline village, NI-1:4, Fea. 7, TR7, SFea. 1, (32)	postmold	cf. <i>Artocarpus</i> sp.	-25.0	1787 ± 41	AD 120-350	1830-1600	Liston 2011a
WK-14021	Ridgeline village, NI-2a, Fea. 2, TR9, XV, (48)	intact occupational surface	cf. <i>Diospyros ferrea</i>	-26.2	1767 ± 44	AD 130-390	1820-1560	Liston 2011a
Ngaremlengui								
WK-28525	Ked era Aranguong, NM-3:16, TR 2, SFea. 1, 85	floor of large pit	1 taxon unident. woody species (Unknown 5)	-24.3	2048 ± 30	170 BC-AD 30	2120-1920 BP	Liston, thesis
WK-28531	Ngedelchong Crown, NM-3:j1, TR 13, V, 92	base of basin	cf. <i>Rhizophora</i> sp.	-24.0	2037 ± 30	170 BC-AD 50	2120-1900 BP	Liston, thesis
WK-28534	Ngedelchong Crown, NM-3:j1, TR 13, F1, 184	small pit cut into saprolite, base of larger pit	1 taxon unident. woody species (Unknown 1)	-26.7	1995 ± 30	60 BC-AD 80	2010-1870 BP	Liston, thesis
WK-28532	Ngedelchong Crown, NM-3:j1, TR 13, E, 145	pit matrix associated with lens of pottery	cf. <i>Glochidium</i> sp.	-23.7	1895 ± 30	AD 50-220	1900-1730 BP	Liston, thesis

Sample No. [^]	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
		sherds						
WK-28528	Ked era Aranguong, NM-3:16, TR 8, IV, 95	matrix in base of large pit, associated with lens of pottery sherds	cf. <i>Bruguiera gymnorhiza</i>	-25.4	1808 ± 30	AD 120-260 (88%), AD 280-330 (7.4%)	1830-1690 BP (88%), 1670-1620 BP (7.4%)	Liston, thesis
WK-28520	Sisngebang, NM-1:7, TR 11, VIIb, 105	pit matrix – ceremonial cultivation?	cf. <i>Cocos nucifera</i>	-26.9	1752 ± 30	AD 210-390	1740-1560 BP	Liston, thesis
WK-28527	Ked era Aranguong, NM-3:16, TR 5, IV, 48	burn event in lower intact living surface	Arecaceae	-26.0	1719 ± 30	AD 240-400	1710-1550 BP	Liston, thesis
Ngarchelong								
WK-5905	Bischerad, NE-4:8, TU2, III, (45-55)	construction fill	<i>Cocos nucifera</i> stem	-26.2	1888 ± 67	40 BC-AD 260 (93.9%), AD 290-320 (1.5%)	1990-1690 (93.9%), 1660-1630 (1.5%)	Tuggle 2007
UCLA-1762I	Badrülechau, NE-4:4, Hill Test, IIB, charcoal concentration	charcoal concentration	charcoal	--	1800 ± 80	AD 50-420	1900-1530	Osborne 1979
Ngatpang								
WK-14068	Ngermedangeb, NT-2:2, Profile 1, SFea. 2, (304)	rock-filled pit	cf. <i>Dodonaea viscosa</i>	-27.7	1907 ± 39	AD 10-220	1940-1730	Liston 2011a
WK-13959	Ngebars, NT-3:10, Profile 3, SFea. 4/2, (300)	pit on crown	<i>Rhizophora</i> sp.	-25.5	1851 ± 47	AD 50-260 (93.7%), AD 300-320 (1.7%)	1900-1690 (93.7%), 1650-1630 (1.7%)	Liston 2011a
WK-14080	Ngermedangeb, NT-2:2, Profile 1, Ivb, (142)	potential pondfield	1 taxon unident. woody species	-26.4	1817 ± 39	AD 80-260 (87.4%), AD 280-330 (8.0%)	1870-1680 (87.5%), 1670-1620 (7.9%)	Liston 2011a
WK-13968	Ngebars, NT-3:10, Profile 3, SFea. 4/1, (150)	pit on crown	1 taxon unident. woody species	-25.1	1805 ± 43	AD 120-340 (93.1%), AD 80-110 (2.3%)	1830-1610 (93.1%), 1870-1840 (2.3%)	Liston 2011a
WK-14067	Ngermedangeb, NT-2:2, Profile 1, VIIb, (190)	intact occupational surface	cf. <i>Rhizophora</i> sp.	-24.8	1800 ± 39	AD 120-350	1830-1610	Liston 2011a
WK-14066	Ngermedangeb, NT-2:2, Profile 1, SFea. 1, (240)	structural support post	charred plant tissue	-27.6	1727 ± 39	AD 230-420	1720-1530	Liston 2011a
WK-14032	Ngermedangeb, NT-2:2, Profile 1, VIIe, (220)	burn event	cf. <i>Maytenus palauica</i>	-25.2	1707 ± 38	AD 240-420	1710-1530	Liston 2011a
WK-14074	Ngebars, NT-3:10, Profile	erosion, ditch	1 taxon unident.	-27.6	1656 ± 39	AD 320-470 (76.5%),	1630-1480 (76.5%),	Liston

Sample No. [^]	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
	3, SFea. 2, IIm, (304)		woody species			AD 480-540 (10.7%), AD 250-300 (8.2%)	1470-1410 (10.7%), 1700-1650 (8.2%)	2011a
Airai								
B-116306	Ngersung area, IR-2:15, TRW, East Face, SFea. 1	hearth	<i>Cocos nucifera</i> , mangrove species, Pandanus sp.	-25.5	1840 \pm 60	AD 50-340	1900-1610	Olmo 1998
WK-20070	Omsangel, IR-1:14, Fea. 1, TR1, VI (110)	intact occupational surface, hilltop /crown	1 taxon unident. woody species	-25.4	1767 \pm 32	AD 130-380	1820-1570	Liston 2007b
WK-19477	Omsangel, IR-1:14, Fea. 1, TR1, Va (95)	construction fill, hilltop / crown	cf. <i>Caesalpinia</i> sp.	-26.2	1700 \pm 31	AD 250-420	1700-1530	Liston 2007b
Melekeok								
WK-29179	Roismelech, ME-4:3, Profile, V, 440	intact occupational surface	<i>Intsia bijuga</i>	-25.1	1966 \pm 32	40 BC-AD 130	1990-1820	Liston, thesis
WK-29178	Roismelech, ME-4:3, Profile, V, 350	intact occupational surface	<i>Intsia bijuga</i>	-24.9	1947 \pm 32	50 BC-AD 90 (93.1%), AD 100-120 (2.3%)	2000-1860 (93.1%), 1850-1830 BP (2.3%)	Liston, thesis
B-96307	Ngerulmud, ME-11:1, CAP-14, Test 2, IV, (65-70)	intact occupational surface, hilltop /crown	cf. <i>Intsia bijuga</i> , cf. <i>Pongamia pinnata</i> , cf. <i>Sonneratia alba</i>	-25.9	1770 \pm 110	AD 1-550	1950-1400	Liston et al. 1998
WK-5932	Engoll, ME-8b, TR2, SU2, IIIa, (60)	intact occupational surface, hilltop /crown	cf. <i>Cocos nucifera</i>	-26.4	1746 \pm 72	AD 80-440	1870-1510	Kaschko 2007
WK-5931	Engoll, ME-8b, TR2, SU1, IIIa, (70-85)	intact occupational surface, hilltop /crown	<i>Cocos nucifera</i> nutshell	-25.1	1690 \pm 80	AD 130-540	1820-1410	Kaschko 2007
B-96306	Ngerulmud, ME-11:1, CAP-14, posthole, (70-80)	structural post, hilltop /crown	Palm sp., cf. <i>Intsia bijuga</i> , unidentified wood	-28.2	1670 \pm 90	AD 130-570	1820-1380	Liston et al. 1998
WK-5933	Engoll, ME-8b, TR2, SU5, IIB, (310-325)	erosion, ditch	<i>Cocos nucifera</i> nutshell	-25.1	1640 \pm 100	AD 130-620	1820-1330	Kaschko 2007
B-100021	Earthworks, ME-8:2, Fea. 3, TP6, V/12, (95-1055)	erosion? construction fill?	<i>Cocos nucifera</i> , + 1 other taxon	-26.7	1680 \pm 70	AD 210-550	1740-1400	Kaschko 2005
Late Phase (~1500–1100 BP)								
ANU-11685	Ngemeduu, NA-4:11,	construction fill,	charcoal	-28.7	1630 \pm 30	AD 340-540	1610-1410	Phear

Sample No.^	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
	TR1a, VIII	hilltop /crown						2007
B-92164	Bukl, NA-5:7, EU3, III/9, (50-55)	erosion? construction fill?, hilltop /crown	charcoal	-27.3	1600 ± 50	AD 340-580	1610-1370	Henry et al. 1996
WK-26998	Ngeskebei, NM-1:5, TR 6, IIb, 70	construction fill; first construction event of component	cf. seed embryo	-27.6	1565 ± 30	AD 420-570	1530-1380 BP	Liston, thesis
WK-5930	Ridgeline village, NI-1:4, Fea. 3, TR1, SU2, IIId, (205-210)	erosion, ditch	cf. legume	-25.4	1530 ± 60	AD 410-640	1540-1310	Kaschko 2007
WK-8294	Roisingang, NA-2:5, Fea. 6, TR1c, SFea. B, (103)	possible burial pit-knob on crown	cf. <i>Bruguiera gymnorrhiza</i>	-27.1	1520 ± 60	AD 420-650	1530-1300	Tuggle 2011
UCLA-1762E	Ked ra Ikirong, NC-3:1, TR1, III, (37-43)	construction fill, hilltop /crown	charcoal	--	1480 ± 80	AD 400-680	1550-1270	Osborne 1979
WK-14030	Ngebars, NT-3:10, Profile 3, SFea. 3b/1, (200)	palisade post, ditch	cf. <i>Pterocarpus indicus</i>	-27.1	1473 ± 38	AD 530-660 (94.4%), AD 460-480 (1.0%)	1420-1290 (94.4%), 1490-1470 (1.0%)	Liston 2011a
WK-28529	Ked era Aranguong, NM-3:16, TR 9, SFea. 2, 110	erosional fill in water control ditch	1 taxon unident. woody species (Unknown 2)	-26.4	1460 ± 30	AD 540-650	1400-1300 BP	Liston, thesis
WK-28522	Sisngembang, NM-1:7, TR 15, VI, NW Pit, 100	basin - pit matrix – cereminal cultivation?	1 taxon unident. woody species (Unknown 3)	-26.3	1438 ± 30	AD 560-660	1385-1295 BP	Liston, thesis
WK-14031	Ngebars, NT-3:10, Profile 3, SFea. 3b, IIIi, (110)	erosion, ditch	cf. <i>Casuarina equisetifolia</i>	-28.5	1431 ± 39	AD 560-670	1390-1280	Liston 2011a
ANU-11686	Ngemeduu, NA-4:11, TR1a, VII	construction fill	charcoal	-27.8	1420 ± 30	AD 580-660	1370-1290	Phear 2007
B-100013	Ngermedangeb, NT-2:2, TP1, II/5, (40-50)	erosion	<i>Bruguiera gymnorrhiza</i> , <i>Garcinia</i> sp., <i>Cocos nucifera</i> , +5 other taxa	-23.8	1400 ± 70	AD 530-780 (93.3%), AD 440-490 (2.1%)	1420-1170 (93.3%), 1510-1460 (2.1%)	Wickler 2005

Sample No. [^]	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
B-251085	Oratelruul Ridge, NI-2:35, TR 1, SFea. 6,	pit in deep basin on crown summit	cf. Euphorbiaceae	-26.0	1390 \pm 40	AD 570-690	1380-1260 BP	Liston 2009
B-92162	Bukl, NA-5:7, EU4, III/1, (42)	erosion? construction fill?	charcoal	-26.3	1390 \pm 100	AD 430-870	1520-1080	Henry et al. 1996
WK-8293	Roisingang; NA-2:5, Fea. 6, TR1b, SFea. B, (100)	possible burial pit-knob on crown	cf. <i>Bruguiera gymnorhiza</i>	-26.4	1380 \pm 60	AD 550-780	1400-1170	Tuggle 2011
WK-14076	Ngebars, NT-3:10, Profile 3, SFea. 3b, IIIg, (280)	burn event, ditch	1 taxon unident. woody species	-26.7	1342 \pm 41	AD 620-780	1330-1170	Liston 2011a
WK-28519	Sisngembang, NM-1:7, TR 8, VIII, 98	small pit matrix, cut into saprolite	1 taxon unident. woody species (Unknown 3)	-25.6	1320 \pm 30	AD 650-780	1300-1170 BP	Liston, thesis
WK-5935	Earthworks w/ Stonework, NI-1:2, Fea. 3, TR2, SU2, IIIa, (170-175)	intact occupational surface	1 taxon unident. woody species	-25.6	1313 \pm 67	AD 610-880	1340-1070	Kaschko 2007
WK-5915	Isakos, NA-3:1, TU2, II, (80-90)	construction fill, hilltop /crown	<i>Cocos nucifera</i> nutshell	-25.0	1312 \pm 66	AD 610-880	1340-1070	Tuggle 2007
WK-8295	Roisingang, NA-2:5, Fea. 6, TR7, SFea. D, (124)	pit, related to burial pit?, knob on crown	cf. <i>Cocos nucifera</i>	-24.0	1310 \pm 70	AD 610-890	1340-1060	Tuggle 2011
WK-5913	Isakos, NA-3:1, TU1b, IV, (85)	cultural deposit, hilltop /crown	<i>Cocos nucifera</i> nutshell	-26.7	1306 \pm 57	AD 640-880	1310-1070	Tuggle 2007
WK-5919	Isakos, NA-3:1, TU1b, VI, (140)	cultural deposit, hilltop /crown	1 taxon unident. woody species	-26.1	1303 \pm 66	AD 630-890	1320-1060	Tuggle 2007
WK-28521	Sisngembang, NM-1:7, TR 11, VI, 55	in pot cache	<i>Intsia bijuga</i>	-26.1	1296 \pm 30	AD 660-780	1290-1170 BP	Liston, thesis
B-92165	Bukl, NA-5:7, EU3, II/8, (40-45)	erosion? construction fill?; hilltop /crown	charcoal	-25.0	1260 \pm 50	AD 660-880	1290-1070	Henry et al. 1996
WK-27006	Ngeskebei, NM-1:5, TR 4, SFea. 2, 150	garbage pit matrix – cut into C horizon	cf. <i>Artocarpus altilis</i>	--	1253 \pm 30	AD 670-870	1280-1080 BP	Liston, thesis

Sample No.^	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
WK-28523	Sisngebang, NM-1:7, TR 15, XI, E Pit, 94	basin - central pit matrix – cereminal cultivation	cf. <i>Bruguiera gymnorrhiza</i>	-26.4	1246 ± 30	AD 680-880	1270-1080 BP	Liston, thesis
WK-5918	Isakos, NA-3:1, TU2, II, (90-100)	construction fill, hilltop /crown	1 taxon unident. woody species	-26.1	1243 ± 67	AD 650-900 (97.1%), AD 910-950 (3.7%)	1300-1050 (91.7%), 1040-1000 (3.7%)	Tuggle 2007
WK-5914	Isakos, NA-3:1, TU2, II, (40-50)	construction fill, hilltop /crown	cf. <i>Bruguiera</i> sp.	-26.2	1243 ± 66	AD 650-900 (92.1%), AD 910-950 (3.3%)	1300-1050 (92.1%), 1040-1000 (3.3%)	Tuggle 2007
WK-27003	Ngeskebei, NM-1:5, TR 1, IV, 150	erosional fill in pit (ditch?) cut into C horizon	1 taxon unident. woody species (Unknown 2)	-25.3	1234 ± 30	AD 680-880	1270-1070	Liston, thesis
B-100017	Isakos, NA-3:1, TP1, IV/V, (76-89)	construction fill, hilltop /crown	<i>Bruguiera gymnorrhiza</i> , + 9 other taxa	-27.4	1220 ± 50	AD 670-900 (93.0%), AD 920-950 (2.4%)	1280-1050 (93.0%), 1030-1000 (2.4%)	Addison 2005
B-236597	Tabelmeduu, NA-4:15, Fea. 17, TR 2, IIIb, (138)	intact occupational surface	1 taxon unident. plant material	-25.4	1220 ± 40	AD 680-900	1270-1050	Liston 2008
WK-14061	Roisingang, NA-2:5, Profile 2, Pit, I, (80)	lg. pit with partial/ whole pots	1 taxon unident. woody species	-26.8	1218 ± 43	AD 680-900 (94.3%), AD 920-940 (1.1%)	1270-1050 (94.3%), 1030-1010 (1.1%)	Liston 2011a
WK-5910	Isakos, NA-3:1, TU1b, IIb, (20-30)	construction fill; hilltop /crown	<i>Cocos nucifera</i> nutshell	-24.4	1210 ± 66	AD 670-970	1280-980	Tuggle 2007
WK-14079	Ngermedangeb, NT-2:2, Profile 1, SFea. 3, (78)	localized burn event	Palm sp.	-26.0	1209 ± 38	AD 680-900 (93.9%), AD 920-940 (1.5%)	1270-1050 (93.9%), 1030-1010 (1.5%)	Liston 2011a
WK-5911	Isakos, NA-3:1, TU1b, IIb, (40-50)	construction fill, hilltop /crown	<i>Cocos nucifera</i> nutshell	-24.2	1209 ± 66	AD 670-970	1280-980	Tuggle 2007
WK-8296	Roisingang, NA-2:5, Fea. 6, TR10, II, (52)	cultural deposit on crown	cf. <i>Cocos nucifera</i>	-23.2	1200 ± 60	AD 680-980	1270-970	Tuggle 2011
WK-5916	Isakos, NA-3:1, TU2, II, (100-110)	construction fill, hilltop /crown	<i>Cocos nucifera</i> nutshell	-24.7	1187 ± 66	AD 680-990	1270-960	Tuggle 2007
Transitional Era (~1100-700 BP)								
WK-27010	Nkebeduul, NM-7:j1, TR 9, SFea. 2, 75	large pit matrix, water control ditch?	1 taxon unident. woody species (Unknown 4)	-29.0	1205 ± 30	AD 760-900 (86.1%), AD 700-750 (9.3%)	1190-1050 (86.1%), 1260-1200 (9.3%)	Liston, thesis

Sample No. [^]	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
WK-5936	Earthworks w/ Stonework, NI-1:2, Fea. 3, TR1, SU1, Ib, (30-45)	construction fill	cf. <i>Bruguiera</i> sp.	-25.8	1165 \pm 67	AD 680-1010	1270-940	Kaschko 2007
WK-28517	Sisngembang, NM-1:7, TR 3, III, 52	intact cultural horizon	1 taxon unident. woody species (Unknown 1; Set 2)	-26.6	1159 \pm 30	AD 770-970	1180-980	Liston, thesis
WK-28524	Sisngembang, NM-1:7, TR 16, B1, VI, 80	burial pit	cf. <i>Rhizophora</i> sp.	-25.2	1179 \pm 30	AD 770-970	1180-980 BP	Liston, thesis
B-92163	Bukl, NA-5:7, EU2, III-IV/13, (60-65)	erosion?, construction fill?; hilltop /crown	charcoal	-24.7	1140 \pm 40	AD 770-990	1180-960	Henry et al. 1996
B-92160	Bukl, NA-5:7, EU4, Fea. B, (61-66)	hearth, hilltop /crown	charcoal	-29.7	950 \pm 80	AD 960-1260 (94.1%), AD 900-920 (1.3%)	990-690 (94.1%), 1050-1030 (1.3%)	Henry et al. 1996
WK-13962	Traditional Cultural Deposits/Stonework, NA-2b, Profile 1, SFea. 2, (147)	garbage pit	cf. palm/fern sp.	-24.6	984 \pm 41	AD 980-1160	970-790	Liston 2011a
B-117387	Earthworks w/ Stonework, OR-12:10, Fea. 5, TR5, II, (20)	intact occupational surface	charcoal	-25.7	840 \pm 50	AD 1110-1280 (82.5%), AD 1040-1100 (12.9%)	840-670 (82.5%), 910-850 (12.9%)	Magnuson and Liston 1998
WK-28526	Ked era Aranguong, NM-3:16, TR 5, II, 30	upper intact living surface	1 taxon unident. woody species (Unknown 1; Set 2)	-25.9	776 \pm 30	AD 1210-1290	735-670	Liston, thesis
WK-5907	Earthworks w/ Stonework, NA-5:12, Fea.4, TU3, SFea. B, (65-85)	pit	<i>Cocos nucifera</i> nutshell	-25.2	751 \pm 68	AD 1150-1330 (83.9%), AD 1340-1400 (10.2%), AD 1050-1080 (1.3%)	800-620 (83.9%), 610-550 (10.2%), 900-870 (1.3%)	Tuggle 2007
Stonework Era (~700–150 BP)								
ANU-11610	Toietmeduu, NA-4:12, TR5, IV	erosion, ditch	charcoal	-17.0	770 \pm 20	AD 1220-1280	730-670	Phear 2007
WK-28516	Nkebeduul, NM-7:jl, TR 8, III, 20	intact cultural deposit	<i>Cocos nucifera</i>	-23.5	647 \pm 30	AD 1280-1400	670-550	Liston, thesis

Sample No.^	Provenience (cmbs)	Context	Sample Material	¹³ C/ ¹² C Ratio	Conventional Age	Calibrated Age BC/AD (2 σ)*	Calibrated Age BP (2 σ)*	Reference
WK-5912	Isakos, NA-3:1, TU1b, IIb, (60-70)	construction fill, hilltop /crown	<i>Cocos nucifera</i> nutshell	-24.7	610 ± 75	AD 1270-1440	680-510	Tuggle 2007
B-236598	Tabelmeduu, NA-4:15, Fea. 17, TR 2, VIIIa, (90)	cultural horizon in bermed basin	cf. <i>Cerbera</i>	-24.2	510 ± 40	AD 1380-1450 (81.0%), AD 1310-1360 (14.4%)	570-500 (81.0%), 640-590 (14.4%)	Liston 2008
WK-27002	Ngeskebei, NM-1:5, TR 4, XII, 80	intact cultural horizon	cf. <i>Pteridophyta</i>	-29.7	476 ± 30	AD 1400-1460	545-495	Liston, thesis
WK-27008	Ongelwatel, NM-1:1, TR 1, 60	pot matrix; under stone paving	Arecaceae	-28.2	363 ± 30	AD 1440-1530 (49.9%), AD 1540-1640 (45.5%)	510-420 (49.9%), 410-310 (45.5%)	Liston, thesis
WK-27007	Ngeskebei, NM-1:5, TR 4, SFea. 6, 40	posthole matrix	cf. <i>Maytenus palauica</i>	-25.9	356 ± 30	AD 1450-1640	500-310	Liston, thesis
WK-26999	Ngeskebei, NM-1:5, TR 6, VIII, 50	truncated cultural horizon	cf. <i>Glochidium</i> sp.	-27.3	306 ± 30	AD 1480-1650	470-300	Liston, thesis
WK-28533	Ngedelchong Crown, NM-3:j1, TR 13, II, 22	intact cultural deposit; on crown	cf. <i>Parkia parvifolia</i>	-26.5	312 ± 30	AD 1480-1650	470-300	Liston, thesis
WK-27001	Ngeskebei, NM-1:5, TR 4, SFea. 1, 90	posthole matrix	cf. <i>Acalypha amentacea</i>	-22.6	240 ± 30	AD 1630-1690 (54.3%), AD 1730-1810 (29.9%), AD 1520-1560 (6.1%), AD 1930... (5.0%)	320-260 (54.3%), 220-140 (29.9%), 430-390 (6.1%), 20... (5.0%)	Liston, thesis
Anomaly								
WK-26997	NM-7:j1, TR 8, III, 20	anomaly	1 taxon unident. woody species (Unknown 1)	-26.2	2355 ± 30	520-370 BC	2470-2330 BP	Liston, thesis

*Calibrated using OxCal v. 3.10 software (Bronk Ramsey 2005, atmospheric data from Reimer et al. 2004) at two standard deviations (95.4% probability) using the Intcal04 calibration curve.

^Grey shaded assays are those collected during thesis investigations.

